RHODORA, Vol. 102, No. 912, pp. 439–513, 2000

FLORISTIC INVENTORY OF THE WACCASASSA BAY STATE PRESERVE, LEVY COUNTY, FLORIDA

J. RICHARD ABBOTT[1] AND WALTER S. JUDD[2]

Department of Botany, 220 Bartram Hall,
University of Florida, Gainesville, FL 32611-8526
[1]e-mail: galearis@yahoo.com
[2]e-mail: wjudd@botany.ufl.edu

ABSTRACT. A floristic inventory of the Waccasassa Bay State Preserve in southwestern Levy County, Florida was conducted from April 1996 to December 1997. The 12,488 ha (30,849 acres) Preserve yielded vouchers for a total of 2 charophytes, 24 liverworts, 29 mosses, 43 macrolichens, and 576 vascular plants. Of the vascular plants, there is 1 lycopsid, 12 ferns, 1 cycad, 4 conifers, and 555 angiosperms, 178 of which are monocots. Sixty-nine species are nonindigenous, and 73 species are recorded for the first time from Levy County. Seventy-two species are at or near their northern or southern limits, 18 species have disjunct distributions or very restricted ranges in Florida, and 16 species are Florida endemics or near-endemics. Five natural plant communities, as well as ruderal areas, were recognized based on field observations: tidal marsh, coastal hydric hammock, freshwater pools, basin swamp, and mesic to scrubby flatwoods. Treatment of the coastal hydric hammock as a single highly variable community, as opposed to a mosaic of intermixed communities, was supported by a limited quantitative analysis.

Key Words: Waccasassa Bay, Levy County, floristics, phytogeography, plant communities, Florida

Waccasassa Bay State Preserve is located within the Gulf Hammock in southwestern Levy County, Florida (Figure 1). The Gulf Hammock area, at the southern end of the Big Bend region of Florida, is one of the largest, relatively undeveloped, continuous forests remaining in the state. Gulf Hammock abuts the Gulf of Mexico and is roughly bounded on the north by S.R. 24 and on the east by U.S. 19, with the southern boundary running somewhat parallel to and just north of the Withlacoochee River. The Waccasassa Bay State Preserve is a relatively thin strip that occupies most of the coast of the Gulf Hammock region, with 56 km (35 mi.) of indented shoreline (WBSPR 1997). Tidal marsh and coastal hydric hammock dominate the 9745 ha (24,070 acres) of the terrestrial portion of the Preserve (Figure 2). An additional 2743 ha (6775 acres) are submerged almost entirely by brackish salt water, for a total of 12,488 ha (30,849 acres) in the Preserve

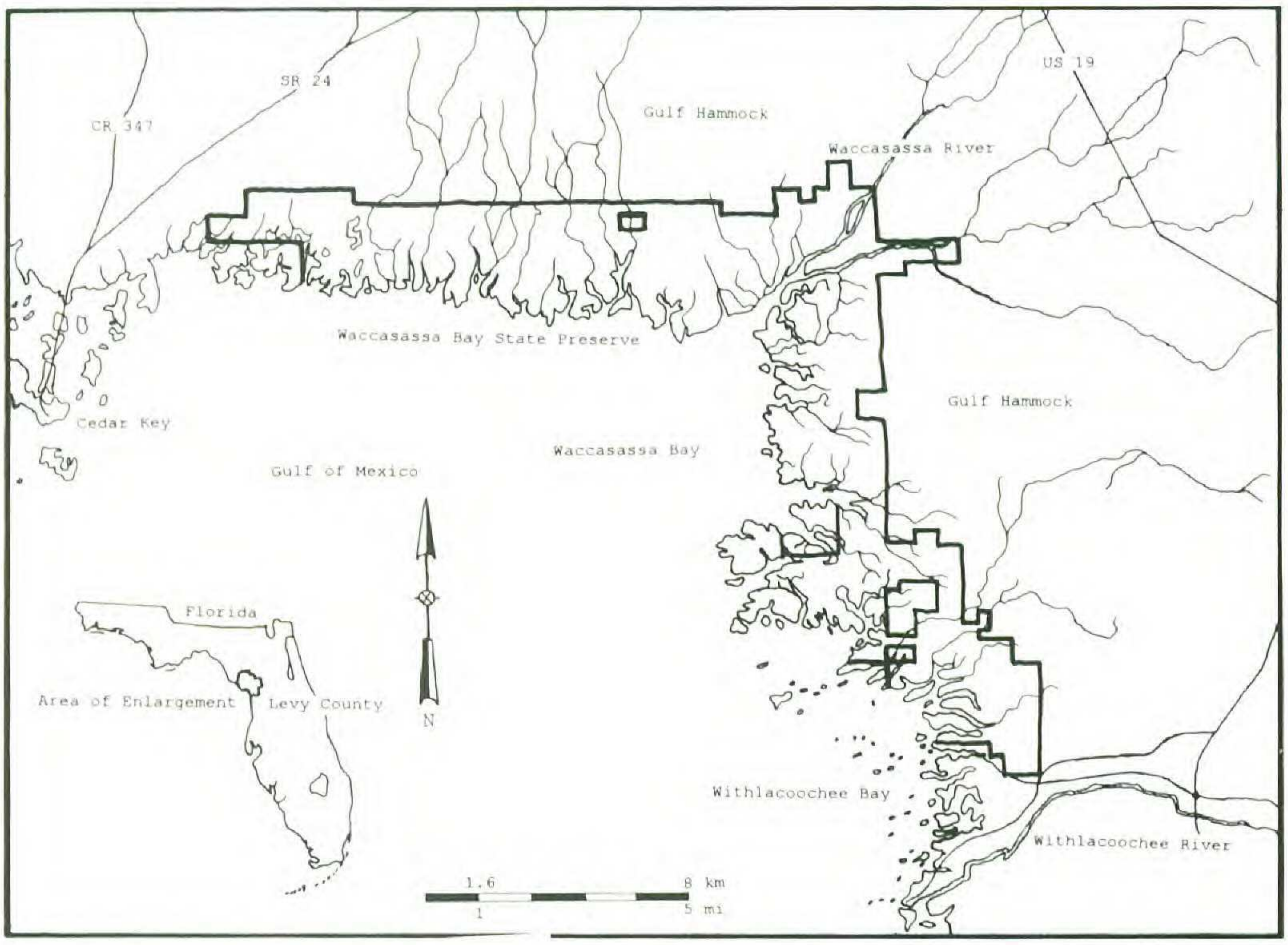


Figure 1. Map of Waccasassa Bay State Preserve and the Gulf Hammock region in southwestern Levy County, Florida.

(WBSPR 1997). During this study, an additional 24 ha (60 acres) at the southern end of the Preserve were purchased. Several additional parcels of land that are slated for purchase would greatly contribute to the extent and diversity of the more inland plant communities (WBSPR 1997).

The Gulf Hammock Wildlife Management Area was established in 1948 (Swindell 1949) and included the area of the more recently established Waccasassa Bay State Preserve. The Preserve was opened in 1972 from land purchased in 1971. Most of the Preserve is surrounded by various hunt clubs on land leased from Georgia-Pacific Railroad, the largest landholder in the Gulf Hammock. A few private inholdings remain within the Preserve. Numerous undeveloped roads transect the Gulf Hammock area, with some of them providing access to gates along the inland boundary of the Waccasassa Bay State Preserve. Public access into the Preserve, however, is legal only by water.

The Florida Department of Environmental Protection (DEP), Division of Recreation and Parks, District 2, manages the Preserve with the principal mission of protecting natural habitat to

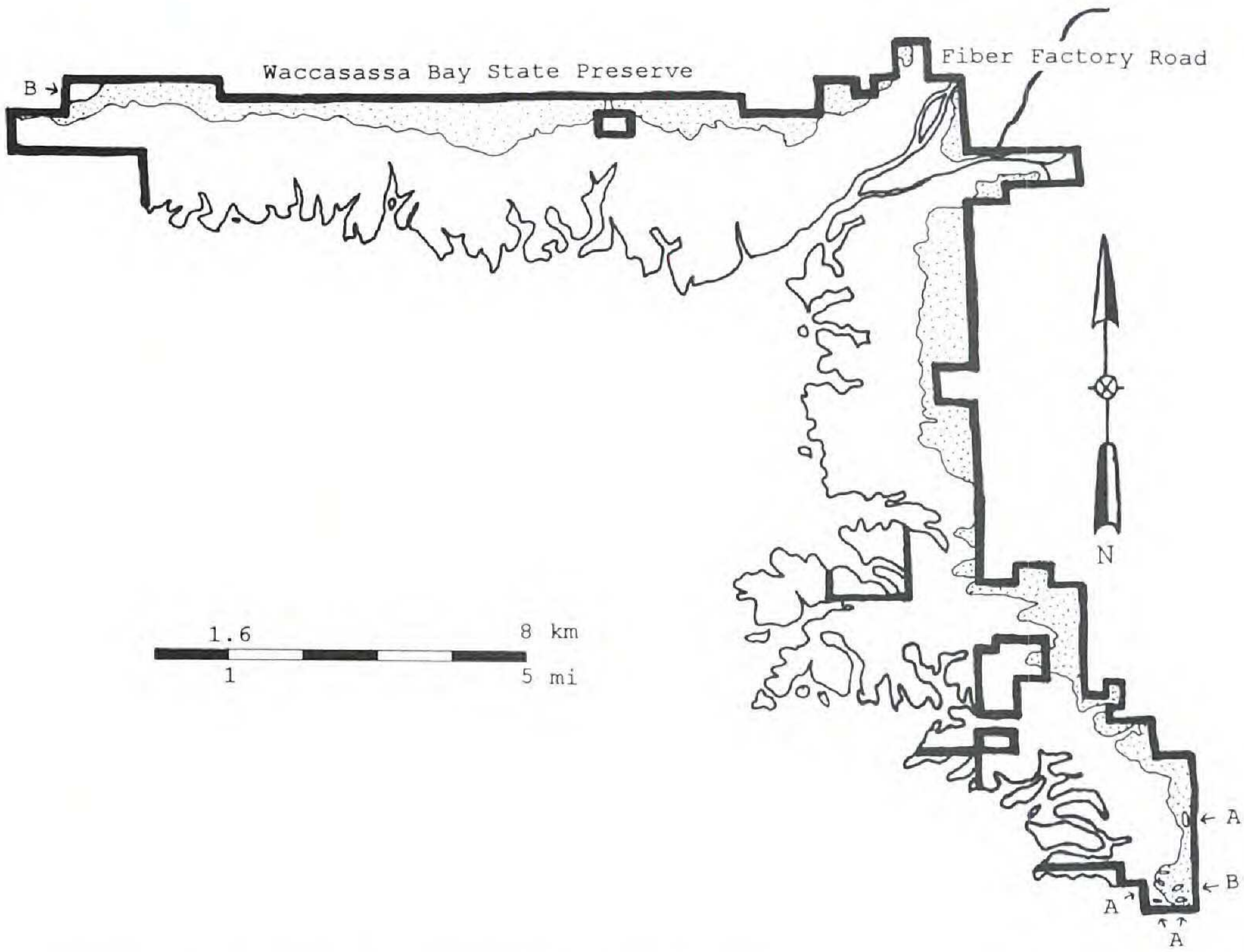


Figure 2. Map of Waccasassa Bay State Preserve, with delimited plant communities. Thick lines within outer boundaries mark private inholdings. White areas are tidal marsh, stippled areas are coastal hydric hammock, "A" represents mesic to scrubby flatwoods, and "B" represents basin swamp.

ensure the survival of rare and endangered plants and animals. The objectives of this floristic study were to document the current flora with representative voucher specimens, to describe the variation and distribution of the plant communities, and to provide a baseline of botanical information for management and field use by DEP personnel and other researchers.

Soils, geology, and physiography. Florida's land area is the highest portion of a plateau that is mostly submerged in the Atlantic Ocean and the Gulf of Mexico. Past sea level fluctuations have variously covered or exposed parts of the Floridian plateau, which is of volcanic origin and now has a deep limestone foundation underlying much of the shallow surface soil (Matter 1990).

The Gulf Hammock region has a low-energy coastal environment without adequate sand to sustain beaches or dunes (Burnson et al. 1984). Very poorly drained, frequently flooded, strongly saline soils of the Tidewater and Cracker series support tidal marsh throughout the Preserve. These mucky soils were formed in loamy and clayey marine sediments underlain by limestone (Slabaugh et al. 1996). Soils of the Wekiva, Demory, and Waccasassa series occur throughout the nontidal Preserve. These poorly drained soils are shallow to moderately deep and were formed in sandy and loamy marine sediments underlain by limestone (Slabaugh et al. 1996).

Inland, the depth of the sandy soil mantle varies in thickness over short distances, related to irregularities in the underlying limestone (Rupert 1988). Field observations by the first author suggest that there may be a trend for the areas of thickest sand to support mesic to scrubby flatwoods, but there is no correlation between this community and areas demarcated on the soil maps of Slabaugh et al. (1996).

Geological formations underlying the uppermost surface Pamlico formation deposits (Pleistocene), in descending order, are the Ocala Group, Avon Park and Lake City Limestones (all Eocene), and Cedar Key Limestone (Paleocene; WBSPR 1997). The Pamlico Terrace is highly varied, due largely to depositional and later erosional patterns, and includes irregular patches of sand or sandy clay illuvium, brackish-water clay or sand and marl; pasty, sandy, nonfossiliferous limestone; and sandy, coquina marl and locally dolomitized marly sand (WBSPR 1997). Rock outcrops, primarily of the uppermost Ocala member of the Ocala group of limestones, are common in the Preserve.

Physiographically, the north peninsular Gulf coast of Florida lies within the Terraced Coastal Lowlands, a broad, flat, topographical subdivision of the Coastal Plain, that comprises sandy, Pleistocene shoreline deposits and erosional, Eocene limestone surfaces (Vernon 1951). Alternatively, the area also is seen as part of the Gulf Coastal Lowlands of the Mid-peninsular Physiographic Zone (Rupert 1988). Following Vernon (1951), the Preserve is entirely within the Pamlico Terrace, an ancient coastline roughly demarcated by the 8 m (25 ft.) elevation line. According to Swindell (1949), the Pamlico Terrace is not recognizable in the Gulf Hammock, and there is no corresponding change in vegetation as it intergrades with the Talbot Terrace, an even older coastline with elevations up to about 30 m. Vernon (1951) further recognized the Preserve area as part of the Coastal Marsh Belt, with a Limestone Shelf and Forested Hammocks zone along the inland edge. Rupert (1988) included the Pamlico Terrace in his more broadly defined Limestone Shelf and Hammocks zone, although he still recognized a Coastal Marsh Belt.

In the Preserve, the coast is often rocky, but marshy, with numerous bays and inlets. Scattered islands dot the shoreline in and near the Preserve. These are not true barrier islands, but were formed as the Gulf of Mexico inundated the coastline, cutting off relic Pleistocene sand dunes and isolating elevated areas from the mainland.

Terrain within the Preserve grades slowly from sea level to about 1.5 m (5 ft.) in places along the inland boundary (WBSPR 1997). Especially near the coast, there are superficial rock beds that are much-eroded and pitted by solution. This karst topography, derived from porous Eocene marine limestones, is an important part of the present-day continental shelf of Florida. Two large springs in the Waccasassa River Basin and scattered small sink-holes provide evidence of the importance of karst topography in the hydrology of the region.

Hydrology. Salt water and coastal climate influences are probably the most important elements that define the floristic communities in the Waccasassa Bay State Preserve. However, most, if not all, truly marine areas lie outside the legal boundaries of the Preserve, which does not include coastal waters. There are numerous inlets which may harbor pockets of marine communities interspersed with estuarine communities. The distinction between marine and estuarine communities relies on the amount of dilution by fresh water, so there is obviously no sharp line of differentiation. There are three sources of fresh water within the Waccasassa Bay State Preserve: rainfall, the Floridan aquifer, and several streams and rivers that all eventually drain into the Waccasassa Bay estuary or Withlacoochee Bay at the southern end of the Preserve.

The Floridan aquifer is a regionally unconfined water table diffused throughout pockets in porous Eocene limestones. Since the uppermost layer of the aquifer, the Ocala Group deposits, are locally exposed, the water table is also at or near the surface throughout the area (Conover et al. 1984). This high water table, in conjunction with the flat terrain, leads to quick soil saturation and surface flooding, which can take weeks to drain after a major storm (Suwannee River Water Management District [SRWMD] 1991). Numerous freshwater pools and wet depressions throughout the forested Preserve are maintained by rainfall. Discharge from the aquifer and rainfall can lead to sheet flow of water across much of the forested Preserve. In the Preserve and in the Gulf Hammock area, the water table discharges via seepage, and it is recharged through direct infiltration of rainwater (Rupert 1988). As suggested by Williams et al. (1997), it is possible that this aquifer discharge is, in part, responsible for locally reducing salinity and maintaining islands of nonhalophytic species in scattered areas near the inland edge of the Preserve's tidal marsh.

All streams north of the Waccasassa River, and a few associated tributaries to the south, are within the jurisdiction of the Suwannee River Water Management District (Burnson et al. 1984). Streams in the southernmost portion of the Preserve lie within the Southwest Florida Water Management District (Waldron et al. 1984). There are 44 named streams and rivers that occur entirely or partially within the Preserve (WBSPR 1997). The most important of these, because of its large drainage basin, is the Waccasassa River, which drains a total of 2424 km^2 (936 $mi.^2$; SRWMD 1991). The Waccasassa River begins as a poorly defined channel connecting swamps and ponds in the Waccasassa Flats of Gilchrist and Alachua Counties and becomes a recognizable channel west of Bronson, well into Levy County. Generally, the Waccasassa River flows to the southwest, where it is fed by Blue Springs and joined by Wekiva Creek, which is fed by Wekiva Springs. Otter Creek and Cow Creek, which is joined by Ten Mile Creek, also flow into the Waccasassa River. Numerous other freshwater creeks and tidal channels drain the western and southern portions of the Preserve.

Estuarine conditions prevail along the north peninsular Gulf coast of Florida due to shallow coastal waters with abundant freshwater discharge from shore. The Waccasassa River and numerous small drainages are the primary sources of fresh water within the Preserve boundary. Cedar Key and nearby islands roughly mark the western limit of the Preserve, but actually have the Suwannee River as the main factor controlling their estuarine habitats (Wolfe 1990). The Withlacoochee River, although barely south of the Preserve, has its entire drainage outside the Preserve, and its freshwater discharge affects only the southernmost portion of the Preserve.

The Waccasassa Bay system is an estuary at the mouth of the Waccasassa River, the largest source of freshwater in the Gulf

Hammock. The bay has an average depth of less than 1 m (3 ft.) at mean low tide. Both the Waccasassa Bay and the Withlacoochee Bay often have a depth of less than 1.5 m (5 ft.) for many miles away from the coast, although there are deeper channels that reflect old stream courses (Swindell 1949). There is no distinct line of separation between the Waccasassa Bay and the Withlacoochee Bay, and both are part of the Big Bend Seagrasses Aquatic Preserve. Tides are primarily diurnal, with a mean range of 0.8 m (2.6 ft.; Hine and Belknap 1986). Tidal influence extends several miles inland along creeks, which support tidal marsh species rather than forested riverine swamp throughout the Preserve.

Coastal waters are multi-use areas and can be negatively impacted by waste discharge, urban runoff, shoreline development, and marine traffic. In the Waccasassa Bay, there are 18,949 ha. (46,800 acres) of approved shellfish harvesting waters, with oyster species offshore and in subtidal and intertidal areas (Gunter et al. 1992). Numerous homes and small developments are present in the Gulf Hammock area, but most are far from inland shorelines along rivers and streams because of the expansive swampy areas. Primary waterfront developments include Williams Camp on the Waccasassa River, Lebanon Station on Ten Mile Creek, and Gulf Hammock on the Wekiva River and Mule Creek. Otter Creek, Bronson, and Usher are in the Waccasassa River drainage basin but not near surface waters (Gunter et al. 1992). Other small towns in the region that serve as possible sources of pollution and disturbance include Cedar Key, Ellzey, Inglis, Rosewood, Sumner, and Yankeetown. The most probable major source of pollution and disturbance near the Preserve comes from extensive logging in the adjacent Gulf Hammock. Clear-cutting could potentially alter surface water flow or lead to contamination via surface runoff, and possible impact should be closely monitored.

Climate. Levy County is at the southern limit of the continental temperate zone, and has a peninsular subtropical climate in coastal areas (Jordan 1984). Summers are long, warm, and humid, while winters are mostly warm but with invasions of cool air from the north (Slabaugh et al. 1996). Relative humidity is often high, with an annual mean of 78% (Swindell 1949). Average relative humidity varies from about 55% in mid-afternoon to about 90% at dawn (Slabaugh et al. 1996). During the summer season, humid breezes from the Gulf of Mexico lead to frequent summer convection storms of high intensity, short duration, and limited extent. Although lightning is a frequent component of these summer storms, the hydrology and the sparse understory contribute to the virtual nonexistence of wildfires in the area (Swindell 1949). From November to February there are prevailing northwesterly to northern winds which bring frontal systems into the area, with precipitation of low intensity, long duration, and wide coverage (Chen and Gerber 1990).

Levy County had an average annual rainfall of 127 cm (50 in.) from 1841 to 1949 (Swindell 1949). During the same time period, at Cedar Key, just west of the Preserve, the average annual rainfall was 119.4 cm (47 in.), but it varied from 68.6 cm (27 in.) to 210.8 cm (83 in.; Swindell 1949). These extremes are similar to those more recently reported for the region, namely, 78.7 cm (31 in.) and 222.3 cm (87.5 in.; Jordan 1984). Within the Waccasassa River Basin, the average annual rainfall from 1977–1989 was 158.8 cm (62.5 in.; SRWMD 1991). These data support the broadly generalized maps of Jordan (1984) and Tanner (1996), which showed several different patterns of rainfall in the Gulf Hammock region. Thus, on average, the westernmost portion of the northern Preserve may receive up to 20 cm (8 in.) less rain annually than the easternmost inland portion of the Preserve. Ironically, it is in this westernmost corner of the northern Preserve that the most well-developed and extensive swamps occur. This surely must reflect drainage patterns and not the direct rainfall patterns.

For the entire region, there is a pronounced rainy season from June to September, during which time 50–60% of the mean annual rainfall occurs. Up to a third of the average annual rainfall often comes in September alone, in conjunction with tropical storms and hurricanes (Jordan 1984). The national record for the most rainfall in a 24 hour period occurred at the southern end of the Preserve in Yankeetown on 5–6 September 1950, with 98.3 cm (38.7 in.). Less than 25% of the yearly rainfall occurs from December to March (Jordan 1984). Relatively severe drought occurs in the spring every 8–10 years on average, infrequently lasting into the early summer (Burnson et al. 1984). The impact of occasional dry spells is probably less defining for the area than the frequent periods of inundation.

At Cedar Key, the average annual temperature is 22.2°C (72°F;

Burnson et al. 1984). From 1841–1949, the average January temperature was 14.7°C (58.4°F), with an extreme low of −9.4°C (15°F; Swindell 1949). During the most severe cold snap in this century, on 21–22 January 1985, temperatures dropped as low as −12.2°C (10°F) in the area (Tanner 1996). The average July temperature at Cedar Key was 27.7°C (81.8°F), with an extreme high of 38.3°C (101°F; Swindell 1949). On average, 100–150 days a year reach a maximum of 35.6°C (88°F) or higher (Tanner 1996). Freezing temperatures, on average, occur 29 days per year (Slabaugh et al. 1996). Frost-free seasons were noted for 6 of 34 years of data from Cedar Key (Swindell 1949).

Average climatic patterns may typify an area, somewhat determining the vegetation, but extremes of hydrology and climate are probably more important for determining actual species composition. Major disturbances, such as hurricanes, though rare, are also important in defining plant community structure and often eventually lead to environmental heterogeneity and increased species richness. Hurricanes occur mostly in the fall, from August to October, with strong winds and often with torrential rains. Sometimes two or three major storms hit or pass near the Preserve in a single year, but usually there are many years between hurricanes that severely impact the area (Matter 1990). Only five hurricanes have hit the coast near Cedar Key since 1871 (Ho and Tracey 1975). A weak tropical storm that hit Cedar Key in October 1941, produced 89 cm (35 in.) of rain inland in just 48 hours (Tanner 1996). Frontal systems in the winter and spring can also lead to dramatic flooding and tidal surges. Given the flat terrain, the high water table, and the far-reaching impact of tidal surges, even a relatively minor storm can flood the area or carry salt water relatively far inland, thus affecting species composition.

Gulf of Mexico currents reportedly moderate the coastal climate, leading to slightly warmer winters and slightly cooler summers along the coast, on average, than are found inland (e.g., Jordan 1984). The depth of inland penetration and the full extent of this current-related climate moderation are questionable, and such moderation must be highly variable locally. Several subtropical plant species at their northern limit are present on coastal islands in the area, while they are absent inland. The dynamic interactions in the area between varying hydrological and climatic extremes contribute to the confusing mosaic of ecotonal plant associations that dominate much of the forested Preserve.

HISTORY

The Waccasassa Bay State Preserve was created in 1972. The Preserve is south of the Suwannee River, well north of Tampa Bay, and just east of Cedar Key, three well-known areas with long histories of human occupation. Historical detail can be found elsewhere [see especially Gannon (1993, 1996), George (1989), Jennings (1951), Milanich (1994, 1995), Swindell (1949), Tebeau (1971), and Webb (1990)], and is summarized in Abbott (1998).

The Gulf Hammock Wildlife Management Area (ca. 40,470 ha. or almost 100,000 acres) was created in 1948, and included all of the land now considered part of the Waccasassa Bay State Preserve. Prior to the Civil War, there was a sugar cane plantation 2 miles south of the community of Gulf Hammock and another on the south bank of Ten Mile Creek. Both of these plantations were just east of the current Waccasassa Bay State Preserve, and both were abandoned at the end of the Civil War, although the latter area had minor farming until around 1900. In the late 1940s, Swindell (1949) found the farmed area to be indistinguishable from surrounding forested areas, suggesting rapid regeneration.

Traditionally, people in the Gulf Hammock area mainly had small gardens and free-ranging livestock. Agriculture has been little-practiced due to the region's poor drainage and shallow soils underlain by limestone. Cattle and hogs were found throughout the area, even well into salt marsh (Swindell 1949). There were large herds of cattle in the area even before 1900. Cattle grazing and hog disturbance, while still common in the Gulf Hammock proper, have been somewhat controlled by fences along much of the boundary of the Waccasassa Bay State Preserve. Signs of hog-rooting were observed only in one part of the northern Preserve, and cows were seen to have breached the fence only in an area south of the Waccasassa River.

Records exist of as many as 20 different lumber companies in the Gulf Hammock area, but specific details are poor or lacking. Some evidence does exist of the impact, as compiled by Swindell (1949) and Jennings (1951), based primarily on oral interviews and old aerial photographs. Bald cypress was logged from swamps shortly after the Civil War. Almost all of the coastal hammock was cut over for southern red cedar and cabbage palm. Red cedar was cut, especially for pencils, from 1875 until about 1920, with mills at Cedar Key and along the coast. Cabbage palms were cut for fiber made from the bud, starting around 1900 and still ongoing as late as 1949. There was a fiber mill on Cow Creek around 1900. During the peak activity, an estimated 100,000 plants were being cut a year. Hardwood logging started later, and probably peaked in the 1920s after most of the cypress and cedar were gone. Numerous logging roads were established in the early 1950s in the areas of driest, firmest soil. Mesic hammocks were more severely affected by logging than were hydric hammocks due to the larger number of suitable timber trees. Swamp trees were rarely cut in the early 1950s since cypress, ash, and swamp tupelo were already largely gone. Logging in Gulf Hammock continues to the present, with logging in the area of the current Preserve possibly into the 1940s or 1950s. Remnants of old logging roads can still be seen, but there is virtually no overland vehicular access within the Preserve now. Presently, many pine stands within the Preserve are being cut in an effort to control a southern pine beetle infestation (*Dendroctonus frontalis*). This disturbance will undoubtedly have a profound impact on plant community structure in the affected areas.

Human activity is by no means the only kind of disturbance that affects plant community composition in the area. Root systems are shallow due to the thin soil underlain by limestone, and heavy winds and storms often blow down large numbers of trees. As mentioned previously, hurricanes sometimes hit the area and, occasionally, severe northern frontal systems come through during the winter or spring. The aftermath of one such storm was witnessed in the spring of 1996 when the first author saw numerous large treefall areas and debris as high as 2 m throughout much of the forest just inland from the salt marsh. One local resident reported an 8 ft. water surge at his house over a mile from the coast.

Despite the relatively recent development (in the last 3000 years) of the current mesic habitats in the Preserve area, the coastal hydric hammock found in the Gulf Hammock area contains virtually all of the diversity and variation known in hydric hammocks found elsewhere in Florida (Vince et al. 1989). It is possible that the area served as a refugium of sorts, as there are a few regionally endemic (or near endemic) animals and plants: *Elaphe obsoleta williamsi,* a type of rat snake described from Gulf Hammock; *Microtus pennsylvanicus dukecampbelli,* the Florida salt marsh vole known only from one location just west of the Preserve (SRWMD 1991); *Pseudobranchus striatus lustricolus,* a subspecies of salamander described from Gulf Hammock, in stagnant mucky water (Neill 1951); and *Spigelia loganioides, Phaseolus smilacifolius,* and *Phyllanthus liebmannianus* ssp. *platylepis.* Additionally, at least two other plant species uncommon in Florida are present in great abundance within the region, namely, *Leitneria floridana* and *Ulmus crassifolia.*

PLANT COMMUNITIES

"Unlike the rest of Florida, much of the north peninsular coastline has not been ditched, diked, graded, filled, or otherwise altered by modern development, giving us a glimpse of what a soggy place the Gulf coast of Florida used to be" (Milanich 1994, p. 210).

An excellent, detailed, ecological characterization of Florida's northern peninsular Gulf coast region was provided by Wolfe (1990). Thompson (1980) described the forest vegetation in the northern Gulf Hammock. Plant communities within the Gulf Hammock area, of which the Waccasassa Bay State Preserve is a part, were described in detail by Jennings (1951), Pearson (1951), and Swindell (1949). Although their studies were zoological in nature and some of their plant identifications, unfortunately unvouchered, are certainly questionable, our own observations largely support their plant community descriptions, which were mostly of areas further inland than the Preserve. Much of the Gulf Hammock floods regularly, altering the species composition somewhat from that typically found in standard community descriptions used elsewhere in the state. Nonetheless, all of the above Gulf Hammock workers described separate coastal, mesic, and hydric forested communities, recognizing that they usually occurred as a mosaic of poorly defined, intermixed small patches. Jennings (1951) captured the essence of the first author's early attempts to understand the vegetation when she wrote that there was "a multiplicity of ecotones, succession stages, and other confusing plant aggregations in the area." As Swindell (1949) pointed out, the size of the area precludes complete field-reconnaissance, and it is almost impossible to distinguish similar communities in the area using aerial photos. Thus, it is likely that undiscovered pockets of vegetation may vary in composition from the descriptions provided here.

In order to make our work maximally useful to other workers in Florida, we followed the community types outlined by the Florida Natural Areas Inventory and Florida Department of Natural Resources (FNAI and FDNR 1990), with one exception as noted later. Our emphasis was on the recognition of plant communities that are discernable based on species composition and not based on potential differences in hydrology related to microtopographical variances.

Five natural communities, in addition to ruderal areas, are here recognized within the Waccasassa Bay State Preserve: tidal marsh, coastal hydric hammock, freshwater pools, basin swamp, and mesic to scrubby flatwoods (Figures 3 and 4). Tidal marsh is the only floral-based group in the Preserve within the combined FNAI marine-estuarine categories. Seagrass beds exist just outside the coastal boundary and are described here as they reportedly occur in scattered localities within the many shore inlets (SRWMD 1991). In the FNAI palustrine category, the basin wetlands group is represented by basin swamp, and the wet flatlands group is represented by a type of hydric hammock. Here, we deviate from the FNAI community description and recognize coastal hydric hammock, following Vince et al. (1989). The term hammock, used primarily on the coastal plain of the southeastern United States, refers to an area of hardwood trees, often in an otherwise treeless or pine-dominated area. Scattered throughout the hydric hammock were numerous freshwater pools not assignable to an FNAI community, yet they were ecologically and floristically distinctive. Finally, in the FNAI terrestrial category, the mesic flatlands group was represented by a mixture of mesic and scrubby flatwoods. Upland mixed forest (synonym: mesic hammock) was frequent just outside of the inland Preserve boundary and is described here since small patches of vegetation transitional to upland mixed forest occur along the inland margin of the Preserve. Ruderal areas can occur within any of the communities but are recognized by their "weedy" aspect, often with signs of human disturbance and nonindigenous plant species.

Even FNAI and FDNR (1990) admit that "FNAI classification is perhaps more often useful . . . in potential natural vegetation rather than existing vegetation" and that community lines are often obscure in the field. As explained below, several other FNAI communities could possibly be recognized within the Preserve, but it is our judgement that the area is best described as a


A
B
C
D

relatively thin coastal strip, predominantly with tidal marsh zones in nonforested areas and highly variable coastal hydric hammock in forested areas. The lack of several distinctive forest communities, as described by others in the Gulf Hammock area, though at first confusing, was eventually understood as a reminder of the arbitrariness of plant community delimitation and of the continuum that often exists between different communities.

All of the FNAI marine-estuarine communities were present along the coastal edge of the Preserve, but the mineral and faunal based community groups were outside the scope of this study, as were algal beds. Tidal swamp (synonym: mangrove forest) did not exist per se, but there were several coastal island areas in the southern portion of the Preserve where black mangrove (*Avicennia germinans*) could be found.

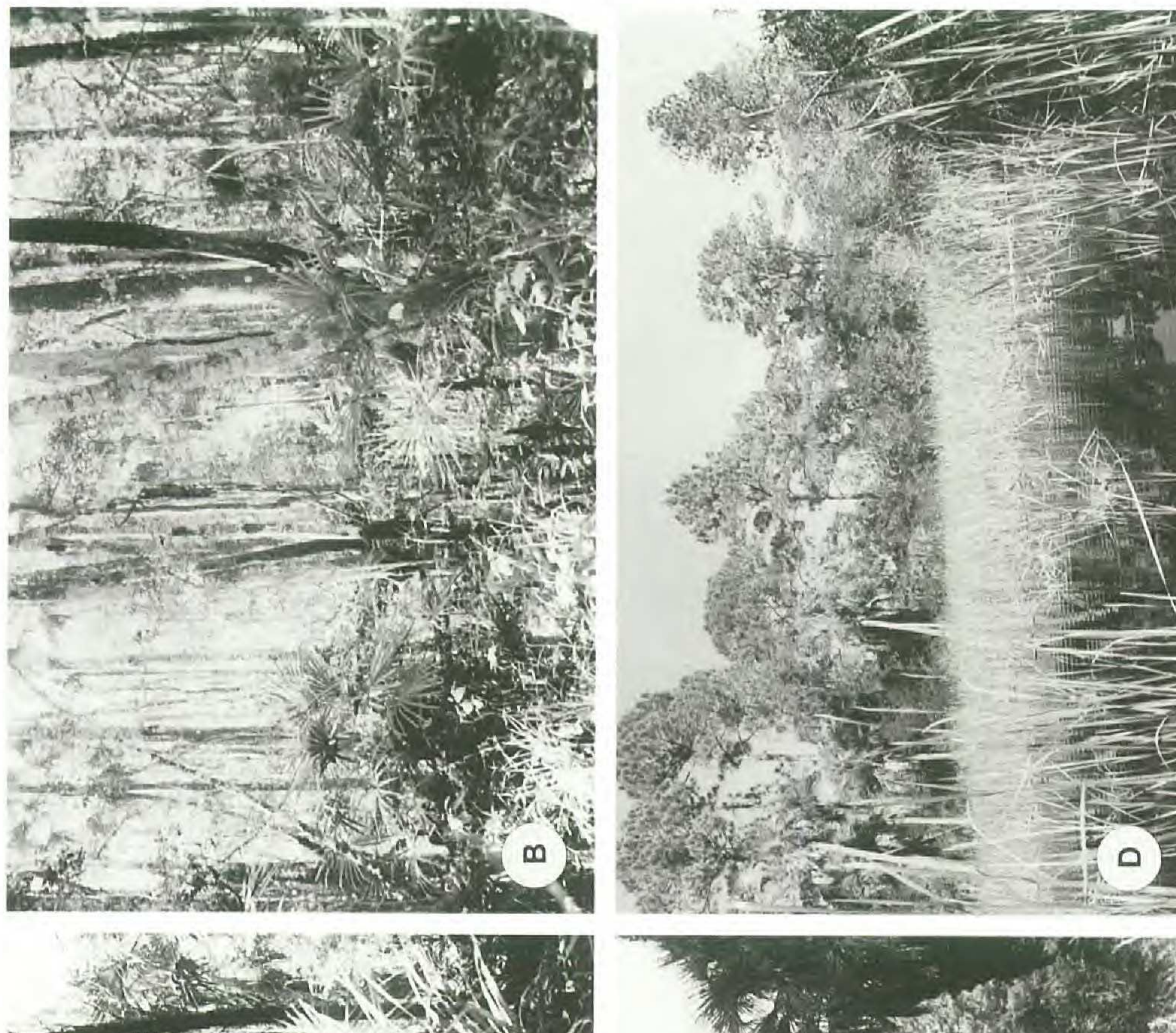
The difference between terrestrial and palustrine systems is that palustrine systems have soil that is inundated or saturated for more than 10% of the growing season, resulting in plant communities that are adapted to regular periods of anaerobic soil conditions (FNAI and FDNR 1990). As mentioned earlier, much of the Preserve and adjacent Gulf Hammock flooded regularly, and the species composition was different from that typically found in similar communities elsewhere in the state. Thus, in an area like the Preserve where widespread inundation followed every storm and heavy rain, the distinction between terrestrial and palustrine systems may not be real or meaningful. Nonetheless, flatwoods and swamp are here recognized as they appeared to be more or less distinct from coastal hydric hammock in a few areas within the Waccasassa Bay State Preserve.

Following terminology of the Florida Natural Areas Inventory, the forested Preserve could be described as an inseparable complex mosaic of northern maritime hammock (synonym: coastal

---

←

Figure 3. Plant communities nearest the coast. A. Tidal marsh abutting coastal hydric hammock near Turtle Creek, dominated by *Juncus roemerianus*; low foreground with *Batis maritima* and *Salicornia perennis*. B. Tidal marsh in southern Preserve, showing tidal channel and *Avicennia germinans*. C. Waccasassa River, banks dominated by *Juniperus virginiana* and *Sabal palmetto*. D. Brackish water pool in southern Preserve; banks dominated by *Juncus roemerianus*, with *Claduim jamaicense*; background shrubs are *Baccharis halmifolia*; background trees are *Pinus taeda*.


A
B
C
D

hammock), mesic hammock, hydric hammock, basin swamp, and several other terrestrial and palustrine communities. In a study of the ecology of hydric hammocks throughout Florida, Vince et al. (1989) recognized the Gulf Hammock region as having its own distinctive variant of hydric forest and called it coastal hydric hammock, including much of the variation described as separate intermixed communities by Jennings (1951), Pearson (1951), and Swindell (1949). The first author quantitatively investigated the variance in this plant community and concluded that the majority of the forested Preserve is best treated as coastal hydric hammock, a highly variable plant community where species typical of many different FNAI communities can be found growing in intermixed patches related to microtopography, hydrology, and past disturbance.

Seagrass beds. In areas west and south of the mouth of the Waccasassa River, which had an unconsolidated mud bottom, sparse to dense seagrass beds occurred. No seagrass species were documented within the Preserve boundary during this study, but it is very likely that at least a few populations occurred within the many coastal inlets. The SRWMD (1991) reported the inshore presence of *Halodule wrightii* and *Halophila engelmanni,* although no vouchers have been seen. A total of five species of seagrass have been reported from the general area, with four of them present between the Cedar Key area and the Withlacoochee River (Iverson and Bittaker 1986). *Thalassia testudinum* (turtlegrass) was reportedly the dominant bed-forming species. *Syringodium filiforme* (manatee-grass), *Halodule wrightii* (shoal-

---

←

Figure 4. Plant communites farther inland. A. Coastal hydric hammock near Turtle Creek; dominated by *Juniperus virginiana* and *Sabal palmetto*; understory very sparse, here with scattered *Chasmanthium* spp. and *Panicum* spp. B. Basin swamp in northwestern corner of Preserve; mixed hardwoods as dominants, here with *Liquidambar styraciflua, Fraxinus caroliniana, Quercus laurifolia,* and *Magnolia virginiana*, with *Taxodium distichum*; note the standing water, cypress knees, and an understory with *Rhapidophyllum hystrix*. C. Scrubby flatwoods along boundary trail off Dewey Allan Park Road; canopy of *Pinus taeda*, with sparse *Sabal palmetto*; understory with *Serenoa repens, Ilex glabra, Quercus myrtifolia, Myrica cerifera, Andropogon* spp., *Rhynchospora* spp., and *Liatris* spp. D. Freshwater pool in southern Preserve; dominated by *Typha domingensis*, with *Pinus taeda* in the background.

grass), and *Halophila engelmanni* were also reportedly present, usually in intermixed beds. *Ruppia maritima* (widgeon-grass), a freshwater to estuarine species, was observed by the first author in the bay near the mouth of the Waccasassa River.

Tidal marsh. Coastal areas frequently inundated by salt water and dominated by salt tolerant herbs are known as tidal marsh (synonyms: salt marsh, coastal marsh, brackish marsh). Tidal marsh here is alluvium-poor, with numerous karst features such as creek channels, circular depression ponds, and limestone outcrops. A mosaic of marshes and coastal hammocks has been created by the low-energy karstic coastline, where small changes in elevation, tidal inundation, soil characteristics, and fresh water flow all control vegetation patterns (Wolfe 1990). In the area, there is usually a very broad continuum from near-marine conditions to near-freshwater conditions. The community was often around 1.5 km wide, although it could be up to 5 km wide in areas, due to the very gradually sloping continental shelf. Numerous tidal creeks with oyster reefs and unvegetated intertidal flats interlace with tidal marsh and support it inland along waterways throughout the width of the Preserve. The following description of variation in tidal marsh is based on the first author's personal observations within the Preserve.

The seaward edge of tidal marsh often consisted of *Spartina alterniflora* (saltmarsh cordgrass) stands. Extensive stands of *Juncus roemerianus* (needle rush) dominated most of the area. Other plants in the *Juncus* stands were sporadic and were most frequently *Aster tenuifolius* and *Solidago sempervirens,* with *Lythrum lineare* locally abundant in a few places. Along the edges of needle rush stands, which sometimes occurred in relatively inland habitats, most of the species mentioned below could also be found.

Open flat depressions, often with exposed limestone, are scattered throughout the tidal marsh. These depressions could be completely bare or have mixed to nearly monospecific stands of the following halophytic species: *Salicornia perennis, Batis maritima, Borrichia frutescens,* and *Distichlis spicata,* or less commonly, *Salicornia bigelovii, Sporobolus virginicus, Sesuvium portulacastrum,* and *Blutaparon vermiculare.* Similar areas, when forming stands just seaward of coastal hammocks, are referred to by FNAI as coastal grassland (synonyms: salt flat, overwash plain, coastal savannah). Reportedly, these areas were historically burned by ranchers to promote better grazing conditions (Pearson 1951). In addition to all of the species found in the depressional flats, these more inland areas usually had *Triglochin striata, Limonium carolinianum, Spartina patens,* and *Agalinis maritima,* often in association with a more or less shrubby transition zone frequently composed of *Iva frutescens, Baccharis halimifolia,* and *Lycium carolinianum,* and occasionally with *Baccharis glomeruliflora, B. angustifolia,* and diminutive *Forestiera segregata.* Areas that appeared to be less saline often had a mixture that could include all of the above species, plus some of the following: *Fimbristylis spadicea, Ipomoea sagittifolia, Bacopa monnieri, Cynanchum* spp., *Eleocharis* spp., *Cladium jamaicense,* and sometimes *Rayjacksonia phyllocephala, Flaveria linearis,* and *Eustoma exaltatum.* All of the above areas frequently occurred adjacent to or intermixed with stands of *Sabal palmetto* (cabbage palm), *Juniperus virginiana* var. *silicicola* (southern red cedar), and *Quercus virginiana* (live oak).

The least brackish areas, not necessarily always the farthest inland (depending on topography), were often dominated by *Cladium jamaicense* and, in a few areas, *Typha domingensis,* often with pockets of *Juncus roemerianus.* Most of the above species could still be found as associates, with the addition of *Acrostichum danaefolium, Crinum americanum,* and *Samolus* spp. The most prevalent submerged plant in inland brackish water was *Ruppia maritima. Myriophyllum pinnatum* occurred in the least brackish areas.

The FNAI beach dune community (synonym: coastal strand), is essentially nonexistent in the area, but two small coastal islands were seen with thin sand deposits. Both areas were bordered by coastal hydric hammock and tidal marsh. One had *Ipomoea pescaprae, Sesuvium portulacastrum, Cyperus esculentus, Cenchrus echinatus,* and *Heliotropium curassavicum.* The other had *Cakile lanceolata, Atriplex pentandra,* and *Chenopodium berlandieri,* with *Sideroxylon celastrinum* nearby. A separate, thin, elongated, raised sandy area parallel to the shore supported a dense stand of giant *Amaranthus australis,* bordered by *Spartina alterniflora* and *Scirpus robustus* on the seaward side and *Juncus roemerianus* on the inland side. Perhaps this area could be considered a poorly developed example of an FNAI coastal berm (synonym: coastal levee).

Numerous slightly elevated islands occur throughout the tidal marsh, with vegetation varying from scrubby flatwoods (only a very few in the southernmost portion of the Preserve) to coastal hydric hammock to entirely herbaceous associations (as described above). The abundant islands of coastal hydric hammock were dominated by *Sabal palmetto* and *Juniperus virginiana* var. *silicicola,* frequently with *Quercus virginiana, Ilex vomitoria, Iva frutescens, Baccharis halimifolia,* and *Opuntia stricta.* Occasional associates included *Pinus taeda, Quercus laurifolia, Forestiera segregata, Yucca aloifolia, Zamia floridana,* and *Stenotaphrum secundatum.* Rarely, almost any of the coastal hydric hammock species, and most individuals of more tropical species, such as *Maytenus phyllanthoides* and *Eugenia axillaris,* could be found on islands. Interestingly, *Persea borbonia,* which is entirely replaced by *P. palustris* inland, seemed restricted in the area to coastal islands. Islands of tall cabbage palms and live oaks in the midst of marsh communities are considered prairie hammocks by FNAI in other parts of Florida, but they are clearly just relict coastal hammock outliers in the Preserve. The inland spread of salt water inundation due to rising sea levels, studied by Williams et al. (1997), has resulted in the die-off of terrestrial species, with relict individuals of cabbage palm, southern red cedar, and live oak. Cabbage palm, *S. palmetto,* is usually the last species to succumb, and scattered clumps, individuals, and standing dead trunks could be found throughout tidal marsh.

Coastal hydric hammock. Hydric hammock is a community virtually restricted to Florida. The most extensive stands of hydric hammock in Florida occur along the Gulf Coast, often forming a belt just inland of salt marsh, and were referred to as coastal hydric hammock by Vince et al. (1989). Throughout the state, hydric hammock varies from nearly monospecific stands of *Sabal palmetto* to mixed stands of *S. palmetto* and *Juniperus virginiana,* or dense hardwood stands with highly variable species composition. Statewide, hydric hammock often has a broadleaf evergreen appearance and is typically dominated by *S. palmetto, J. virginiana, Quercus virginiana,* and/or *Q. laurifolia* (laurel oak), and often also has *Liquidambar styraciflua* (sweetgum) and *Carpinus caroliniana* (hornbeam). Gulf Hammock is the largest contiguous stand of hydric hammock in Florida and includes almost all of the variation in structure and composition found in hydric hammocks throughout the state. Along inland edges of the Gulf Hammock, coastal hydric hammock is usually intermediate with other community types, such as swamps and mesic hammock (Vince et al. 1989). Almost all of the species known to occur in hydric hammock in Florida can be found in the Gulf Hammock (Vince et al. 1989), including relatively rare trees such as *Prunus americana* and *Ulmus crassifolia,* and rare herbs such as *Spigelia loganioides,* all of which were found within the Waccasassa Bay State Preserve. The following descriptions of coastal hydric hammock are based entirely on field observations by the first author.

Areas closest to salt marsh often contained near-pure stands of *Sabal palmetto* and *Juniperus virginiana,* often with an understory of *Iva frutescens, Lycium carolinianum, Baccharis halimifolia,* and *Yucca aloifolia.* Frequently, *Quercus virginiana* also was present in the canopy, with an understory of *Ilex vomitoria, Myrica cerifera, B. halimifolia, Viburnum obovatum,* and often *Forestiera segregata.* This coastal-most forest was the only type of canopy cover included as coastal hammock by authors such as Pearson (1951). This area is reportedly very similar to hydric hammock bordering marshes along the St. Johns and Myakka Rivers (Vince et al. 1989). Occasionally, especially adjacent to inland fingers of tidal marsh, *Pinus taeda, Ulmus* spp., and *Fraxinus* spp. could be locally abundant in the canopy. Lianas were rare in the most coastal areas, which mostly had only *Smilax bona-nox* and *Toxicodendron radicans*; these species increased in abundance with distance inland. Herbs were usually infrequent or lacking in the most coastal areas, and were predominantly represented by scattered salt marsh species and grasses, especially *Chasmanthium* spp. and *Panicum* spp. With increasing distance from the salt marsh, *S. palmetto* and *J. virginiana* decreased in abundance while mixed hardwoods increased. However, within the Preserve, which occupies a narrow coastal strip, there were virtually no areas where *S. palmetto* and *J. virginiana* were not important canopy members.

Inland, trees characteristic of FNAI mesic to hydric hammocks and swamps (i.e., mixed hardwoods) became more common, though rarely did more than two or three of these species occur together. Most such species had a scattered distribution. The following abundance estimates are based on the first author's observations over the entire area of coastal hydric hammock. Frequent woody additions inland were *Pinus taeda, Quercus lauri-*

folia, Ulmus alata, U. crassifolia, U. americana, Acer saccharum ssp. *floridanum,* and *Persea palustris.* Mostly along the inland boundaries, one occasionally found *Carpinus caroliniana, Carya glabra, Diospyros virginiana, Liquidambar styraciflua, Celtis laevigata, Gleditsia triacanthos, Tilia americana, Quercus shumardii, Erythrina herbacea,* and *Sabal minor.* Infrequent woody plants were *Forestiera ligustrina, Morus rubra, Ptelea trifoliata, Rapanea punctata, Sapindus saponaria,* and *Zanthoxylum clava-hercules.* The rarest of the intermixed woody mesic species were *Cercis canadensis, Crataegus aestivalis, Prunus americana, Aesculus pavia, Osmanthus americanus, Viburnum dentatum, Quercus michauxii, Q. nigra, Sideroxylon lanuginosum, Aralia spinosa,* and *Symphoricarpos orbiculatus.* In wet depressions and in areas transitional to swamps, *Fraxinus caroliniana, F. pennsylvanica, Acer rubrum, Magnolia grandiflora,* and rarely *Cornus foemina, Carya aquatica, Nyssa biflora,* and *Ilex cassine,* could be found. Areas transitional to flatwoods had a greater abundance of *Pinus taeda,* but there were also numerous isolated stands of *Pinus taeda* scattered elsewhere through the forest.

Frequent inland lianas were *Vitis* spp., *Smilax bona-nox,* and *Toxicodendron radicans.* Occasional lianas were *Sageretia minutiflora, Smilax auriculata, S. tamnoides,* and *Campsis radicans. Berchemia scandens, Matelea gonocarpos, Bignonia capreolata, Chiococca alba, Parthenocissus quinquefolia, Gelsemium sempervirens, Ampelopsis arborea,* and *Lonicera sempervirens* were infrequent. Rare lianas and vines were *Phaseolus smilacifolius, Smilax smallii, S. laurifolia, Cocculus carolinus, Clematis crispa, C. catesbyana,* and *Dioscorea floridana.*

The ground layer was often bare or with sparse, patchy herbs, such as *Chasmanthium* spp., *Panicum* spp., *Elephantopus elatus,* and *Ruellia caroliniensis.* In the areas that flooded least, a relatively thick ground cover of the same species could develop, along with *Zamia floridana.* Additional woodland herbs that could be found scattered or in patches included numerous sedges and grasses, along with *Salvia lyrata, Galium hispidulum, Rubus* spp., *Elytraria caroliniensis, Dyschoriste humistrata,* and *Sanicula canadensis.* In a few scattered areas grew *Spigelia loganioides, Phyllanthus liebmannianus* ssp. *platylepis, Trepocarpus aethusae, Euphorbia commutata,* and *Lithospermum carolinense.* Bare areas often had a scattering of wetland herbs, described below under freshwater ponds. In many areas, there were thick, lawn-like stands, mostly of *Stenotaphrum secundatum*, with a few areas of *Axonopus furcatus*. Both of these are native grasses, but their growth pattern often seemed unnatural and perhaps reflects remnant areas of old logging roads.

Freshwater pools. Included here are shallow rainwater depressions, relatively deep isolated pools, and isolated inland channels. Most of the areas likely flood with salt water during extreme tidal surges in connection with major storms, but sheet flow of surface rainwater may serve to dilute them sufficiently to maintain their freshwater vegetation. The Florida Natural Areas Inventory does not have a community type that corresponds to the freshwater pools in the Preserve. Since many of them are ephemeral and in depressions, they could be treated as variants of depression marsh (synonyms: isolated wetland, ephemeral pond), but the FNAI habitat description and species lists show nothing in common with these areas. A couple of the deepest ponds (ca. 1.5 m deep) are similar to miniature sinkhole lakes, and could perhaps be treated as versions of them, since they are karstic in origin. But, rather than forcing several ill-fitting FNAI names here that have highly overlapping species compositions, we chose just to describe the variation, without recognizing the pools as a distinct FNAI community, since most of the pools are nothing more than wet depressions whose species are mostly scattered in saturated soil in areas throughout the coastal hydric hammock and basin swamp communities.

Shallow rainwater depressions are common throughout the Preserve. Many of the depressions are ephemeral, and presumably, saturated soil conditions are responsible for supporting wetland plants when there is no surface water. Many depressions were devoid of vegetation or have only two or three species growing in them. *Leitneria floridana* was frequent overall, usually forming dense shrubby stands, often with nearby *Fraxinus* spp. and *Salix caroliniana* in semi-permanently flooded areas. The largest of these depressional areas with long-standing water often appeared very similar to small patches of swamp forest. Most commonly, *Hydrocotyle umbellata, Samolus ebracteatus, S. valerandi, Bacopa monnieri, Sabatia calycina, Lippia nodiflora, Crinum americanum, Cardamine pensylvanica, Pluchea* spp., *Asclepias perennis,* and *Iris hexagona* were found. *Saururus cernuus, Centella* *asiatica, Polygonum hydropiperoides,* and *Ammania latifolia* were also occasionally found in these areas.

Areas of deeply pooled fresh water are uncommon within the Preserve. Only three such areas were seen by the first author. One of them actually had the estuarine *Juncus roemerianus, Spartina patens,* and *Ruppia maritima* in association with *Cladium jamaicense, Leitneria floridana, Hibiscus coccineus,* and *Thalia geniculata.* The other two pools were bordered by *Cladium, Leitneria, Hibiscus,* and *Panicum* spp. One of them also had *Hibiscus grandiflorus* and was filled with submerged and floating mats of *Bacopa monnieri* with *Nitella capillata.* The other pool was more diverse, with a dense stand of *Typha domingensis* in the middle and with *Nymphaea odorata, N. elegans, Chara zeylanica, Myriophyllum pinnatum, Echinodorus berteroi, Sagittaria graminea,* and *Polygonum hydropiperoides* along the edges. This latter pool was highly dynamic during the period of study. The above-listed species were the dominants in the beginning. During a final visit to the area, the first author found *Lemna obscura* and *Ceratophyllum echinatum* to be the dominants, with the original species virtually absent. Closer inspection revealed that the water level had risen by at least half a meter and that many of the original species were still present as small plants along the bottom in about one meter of water. Dozens of other deep pools were seen, with a strong estuarine influence, as indicated by the salt marsh vegetation and brackish water, with only one submerged or floating aquatic, *Ruppia maritima.*

Numerous inland channels were also seen, mostly with an obvious or seasonally intermittent continuity with tidal marsh. In several areas, however, the inland boundary trail cuts across fingers of elongate depressions that appear to be isolated portions of predominantly freshwater creek channels. Vegetation included species found near the depression pools, though it was usually dominated by *Leitneria floridana* and *Hibiscus coccineus.* Additionally, *Sagittaria lancifolia, Kosteletzkya virginica, Rumex verticillatus,* and several graminoids were found primarily along a few of these freshwater channels.

Basin swamp. Basin swamp (synonyms: cypress swamp, hardwood swamp, mixed swamp) occupies low areas that are flooded more frequently for longer periods of time and to a greater depth than hydric hammock (Vince et al. 1989). Only two distinct swamp areas were found within the Preserve, totaling perhaps 15 ha., although several small forest patches in scattered localities had standing water and trees such as *Carya aquatica, Acer rubrum,* and *Fraxinus caroliniana.* Much of the largest swamp area was actually very similar to adjacent coastal hydric hammock and perhaps could have been considered as just another variant form of hydric hammock. But the diminution in abundance of *Sabal palmetto* and *Juniperus virginiana* was distinctive, as was the hydrology, especially in conjunction with the presence of *Taxodium distichum,* which is considered very rare in hydric hammock (Vince et al. 1989). Swamps were also characterized here by the abundance of *Acer rubrum, Nyssa biflora, Fraxinus pennsylvanica, F. caroliniana,* and *Magnolia virginiana*; and by the rare presence of orchids such as *Malaxis spicata, Hexalectris spicata,* and *Habenaria floribunda,* of ferns and allies such as *Selaginella apoda, Thelypteris palustris, T. kunthii,* abundant *Acrostichum danaefolium,* and of other noteworthy plants such as *Lobelia cardinalis* and abundant *Rhapidophyllum hystrix.*

Mesic to scrubby flatwoods. Mesic to scrubby flatwoods (synonym: intermediate pine flatwoods) are typically dominated by *Pinus taeda* (loblolly pine) and *Sabal palmetto.* Hydric hammock species are intermixed, which is not characteristic for mesic or scrubby flatwoods. These areas within the Preserve are not typical for well-developed flatwoods elsewhere in the state. Thus, most of the flatwoods-like areas in the Preserve could easily be seen as just another variant form of a broadly defined hydric hammock plant community. Patches of *P. taeda* occur naturally throughout the Preserve, but along the boundaries of the southern portion, these patches likely reflect past logging, as clear-cut areas were widely replanted with *P. taeda* according to Vince et al. (1989). Aerial photos from the 1950s indicate that many of the areas considered here had been severely logged. Even though these areas would, perhaps, best be treated as a transitional variation of coastal hydric hammock, they are mostly very distinctive in the field and are here recognized as pine-dominated areas with a characteristic assembly of understory species in the southern portion of the Preserve, totaling perhaps 11 ha.

Flatwoods in Florida have poor drainage and low topography, which is true for most of these areas. Fires, usually every 10–20 years, are important in maintaining species composition in flatwoods. Only one area near the coast showed signs of having burned within the last few years, and it had an extremely dense stand of *Serenoa repens* (saw palmetto). *Pinus taeda* (loblolly) is one of the least fire-adapted pines in Florida, but several of these pine-dominated areas in the Preserve did have a little intermixed *P. elliottii* (slash pine), a typical flatwoods species. The preponderance of loblolly and the admixture of species more typical of well-drained sandy areas probably reflect the effects of fire exclusion and human disturbance in the area. The rareness of species typical of scrub suggests that the area most likely was not originally scrub, but an area of flatwoods that has been invaded by scrub species, perhaps due to fire exclusion.

Within the Preserve, canopy members were frequently *Pinus taeda* and *Sabal palmetto,* occasionally with *Juniperus virginiana, Quercus virginiana, Q. laurifolia,* and *Persea palustris.* Rarely, *Magnolia grandiflora, Osmanthus americanus, Q. geminata, Prunus serotina, Carya glabra,* and *Tilia americana* were intermixed. Some of these areas were notably poorly drained and had an understory of *Serenoa repens* and *Myrica cerifera* with scattered *Ilex glabra, Vaccinium arboreum, Lyonia fruticosa,* and *L. lucida.* Dense tangles of *Smilax* spp. were frequent. Other similar areas also had *Hypericum tetrapetalum, H. hypericoides, Carphephorus odoratissimus, Vaccinium myrsinites, Bejaria racemosa,* and *Liatris* spp. Additional rare indicative herbs included *Aster tortifolius, Penstemon multiflorus, Silphium astericus, Lechea mucronata, Bulbostylis stenophylla, Cyperus retrorsus, Buchnera americana, Piriqueta caroliniana,* and *Galactia elliottii.* The most scrubby-looking areas, oddly on sandy pockets adjacent to tidal marsh, also contained *Q. myrtifolia, Asimina longifolia, Myrica cerifera* var. *pumila, Xyris* spp., and *Polygala* spp.

Upland mixed forest. There are no pure stands of upland mixed forest (synonym: mesic hammock) large enough to consider as distinct within the Preserve boundary. Tiny patches along slightly elevated ridges within hydric hammock do approach upland mixed forest, as described by the FNAI and FDNR(1990) and as differentiated by Vince et al. (1989). We include this brief description here since much of the adjacent Gulf Hammock has been described by past workers (e.g., Swindell 1949) as mesic hammock and there may be a few undiscovered areas within the Preserve that would best be treated as mesic hammock.

Pearson (1951) found that even in the Gulf Hammock, mesic hammocks are usually along ridges or islands of better drained soils, without forming large continuous tracts. Although they are a major portion of the overall hammock, an extensive network of lower drainage areas separates the mesic hammock patches. Historically, the mesic hammocks had a very sparse understory with visibility of several hundred meters. Jennings (1951) reported that mesic hammocks can be inundated for several hours after heavy rains to several days after major storms due to poor drainage in the Gulf Hammock. Most of the species reported by Jennings (1951), Pearson (1951), and Swindell (1949) as typical of mesic hammock were found within the Preserve, but they were rarely together in groups of more than 2 or 3 species and occurred primarily along the inland boundaries.

As described in the adjacent Gulf Hammock area (Swindell 1949; Vince et al. 1989), characteristic canopy trees were *Magnolia grandiflora, Quercus michauxii,* and *Acer saccharum* var. *floridanum,* often with *Ostrya virginiana, Tilia americana, Cercis canadensis, Ilex opaca,* and *Pinus taeda.* Other common species that were more widespread, and thus less indicative, were *Carpinus caroliniana, Quercus virginiana, Q. nigra, Liquidambar styraciflua, Sabal palmetto, Juniperus virginiana, Persea palustris, Celtis laevigata, Ulmus alata, Acer negundo,* and *Aralia spinosa.* Common shrubs were *Ilex vomitoria, Serenoa repens, Vaccinium arboreum, Viburnum dentatum, Callicarpa americana, Sageretia minutiflora, Euonymus americana,* and *Myrica cerifera.* Less common shrubs were *Zanthoxylum americanum, Ptelea trifoliata,* and *Rhamnus caroliniana.* Common vines included *Toxicodendron radicans, Ampelopsis arborea, Vitis rotundifolia, Campsis radicans, Parthenocissus quinquefolia, Bignonia capreolata, Gelsemium sempervirens,* and *Smilax bona-nox.* Herbs included *Panicum commutatum, Oplismenus setarius, Elephantopus* spp., *Sanicula canadensis, Mikania scandens, Salvia lyrata, Dioscorea floridana, Melothria pendula,* and *Mitchella repens.*

Ruderal areas. Ruderal, human-created, open areas are very infrequent in the Waccasassa Bay State Preserve, largely due to the lack of roads and legal public access by land. In the Preserve, most ruderal areas would be virtually impossible to distinguish from areas of natural disturbance without the nearby fences and tire ruts, because ruderal areas usually were dominated by native species characteristic of the adjacent communities, a testament to the relatively pristine nature of the Gulf Hammock. Nonetheless, virtually every species documented from the Preserve can be found along or near a trail or road somewhere, so the emphasis here is to point out areas where nonindigenous species are found. Native species restricted to ruderal areas in the Preserve have been marked accordingly in the species list. In accordance with the Preserve's policy for control of exotic species, non-native species were eliminated, when found, in all localities except Fiber Factory Road where sheer numbers made it unfeasible. Undoubtedly, propagules in the soil and re-introduction will maintain the presence of most of the documented species.

The forested boundary has been mowed at least once in the past twenty years for much of the Preserve, creating an open and, in areas, somewhat disturbed trail up to a few meters wide. While the boundary is typically dominated by species native to forest gaps and wet depressions, a few nonindigenous plants rarely were found (e.g., *Apium leptophyllum, Conyza bonariensis, Hyptis mutabilis, Medicago lupulina, Murdannia nudiflora, Paspalum notatum, P. urvillei, Richardia brasiliensis,* and *Spermacoce prostrata).*

There are a few areas where old access roads still exist or where illegal entrance and use have created undeveloped roads into the Preserve. One such road near Turtle Creek had a few individuals of *Medicago lupulina, Mitracarpus hirtus,* and *Secale cereale,* with occasional *Plantago major* and *Youngia japonica.* A few illegal entrance roads at scattered localities were found with *Lindernia crustacea* forming small patches in wet depressions. *Echinochloa crusgalli* and *Polypogon monspeliensis* were found in scattered wet pools. *Stenotaphrum secundatum* is a native species, but its robustness and dense growth along old roadways suggest that the triploid cultivar form may have been introduced in areas.

One public gravel road, Dewey Allen Park Road, actually cuts across tidal marsh in the southwestern-most boundary of the Preserve. Exotics along this road were *Crotalaria spectabilis, Hyptis mutabilis, Lantana camara, Medicago lupulina, Melilotus alba, M. indica, Paspalum urvillei,* and *Verbena brasiliensis,* all of them occasional.

An area known as the Northcut Property is a recent acquisition in the southern end of the Preserve. The area was a homesite, with an undeveloped road transecting it. In this area occurred a single *Albizia julibrissin,* dense *Eremochloa ophiuroides,* infrequent *Medicago lupulina* and *Verbena braziliensis,* and rare *Sphagneticola trilobata.*

Around 4 km (2.5 mi.) of Fiber Factory Road, an undeveloped access road and its right-of-way, are owned by the state and are included in this study, though they are not within the main body of the Preserve. This roughly eight-meter swath cuts through a wide variety of areas on its way to the coast, and perhaps a third or more of the documented species could be found at some point along this road. Just outside the right-of-way, was a large *Melia azedarach,* but no seedlings were seen. Cows were abundant in this area, and several feeders were along the road, with exotic plants concentrated near them. It is in this area that signs of grazing could also be seen inside the Preserve. Exotics here, most of which were only in one or a few small areas, were *Amaranthus spinosus, Arenaria serpyllifolia, Cerastium glomeratum, Conyza bonariensis, Coronopus didymus, Cynodon dactylon, Eleusine indica, Hedyotis corymbosa, Hyptis mutabilis, Kummerowia striata, Kyllinga brevifolia, Lamium amplexicaule, Lindernia crustacea, Medicago lupulina, Murdannia nudiflora, Paspalum dilatatum, P. notatum, Pavonia hastata, Phyllanthus urinaria, Poa annua, Portulaca amilis, Raphanus raphanistrum, Senna obtusifolia, Sonchus asper, Sporobolus indicus, Stellaria media, Trifolium campestre, Verbena brasiliensis, Veronica arvensis, Vicia sativa,* and *Youngia japonica.* Within the Preserve itself, the road continued, locally with dense carpets of *Eremochloa ophiuroides,* with rare intermixed *Cyperus rotundus, Desmodium triflorum,* and *Sisyrinchium rosulatum,* and occasional *Kyllinga pumila, Medicago lupulina, Murdannia nudiflora,* and *Phyllanthus urinaria.* Near this access point, and at two other localities in the forested Preserve, the first author found *Citrus aurantium.*

Along the inland edge of tidal marsh, where piles of wrack accrued after tidal surges, three small plants of *Schinus terebinthifolius* were found. This species was observed in great abundance outside the Preserve on Cedar Key and Seahorse Key. Disseminules are likely to continue to be brought in from numerous other coastal locations as well. One coastal island had a diffuse population of *Cyperus esculentus.* Another island had *Tetragonia tetragonioides* along the salt marsh edge.

Rather extensive logging, though scattered over the last century, has undoubtedly affected species composition in the Waccasassa Bay State Preserve, and has left its mark in the form of old access roads, which mostly have been revegetated by forest species. During the course of this study, there was a southern pine beetle (*Dendroctonus frontalis*) outbreak that necessitated road construction and logging. The full impact of this disturbance remains to be seen. Probably the single most important factor that will shape the future plant communities in the Preserve, however, is the rising sea level. It can be expected that more and more of the Preserve will be inundated and that the plant communities will shift inland.

QUANTITATIVE FLORISTICS: VARIATION WITHIN COASTAL HYDRIC HAMMOCK

When the first author began this floristic inventory, much of the forested Preserve appeared to be a confusing array of possibly distinct plant communities, at least based on canopy dominants. Eventually, he realized that there were areas with distinctive swamp forest and mesic to scrubby flatwoods, but in most of the forested Preserve, here treated as coastal hydric hammock, three canopy extremes were seen, although all shared occasional to abundant *Sabal palmetto* and *Juniperus virginiana.* Many areas, especially those closest to the coast, were dominated by just *S. palmetto* and *J. virginiana* with only a few scattered hardwoods, primarily *Quercus virginiana* and *Q. laurifolia.* Previous workers in the region have called these juniper and *Sabal*-dominated areas coastal hammock (e.g., Swindell 1949). Some areas had a canopy codominated by several mixed hardwoods, including trees such as *Acer rubrum, A. saccharum, Fraxinus caroliniana, F. pennsylvanica, Liquidambar styraciflua,* and several *Quercus* species. These areas with mixed hardwoods seemed similar to mesic hammock and, in places, swamp forest. Other areas had a canopy with abundant *Pinus taeda* and seemed to be a possible variant of flatwoods. We decided to investigate whether the highly variable coastal hydric hammock (according to Vince et al. 1989) might be better treated as a mosaic of intermixed, yet distinctive, plant communities.

A general outline of our approach is as follows. Scattered patches of the three extreme canopy types were located throughout the Preserve. The Preserve was divided into roughly equal northern and southern portions, separated by the Waccasassa River. Using available access points along the Preserve boundaries, aerial photos, a compass, and a hand-held global positioning unit, the first author attempted to ensure that at least one of every three map sections (U.S. Geological Survey topographical quadrangle maps, 7.5 minute series) had a plot placed within it, so that half the plots were scattered over the northern Preserve and half over the southern Preserve. Typically, no more than two plots were placed within an area of 2.6 km^2 (1 $mi.^2$), roughly the amount of area covered by an aerial photo map (Florida Department of Transportation; scale 1 in. = 400 ft.). A plot was placed in each of 26 forest patches. In each plot, the presence of all understory species was recorded. Coefficient of community values (Whittaker 1975), essentially modified percent similarity values, were calculated, comparing all three of the canopy extremes to each other. For comparison, coefficient of community values were calculated between each pair of communities recognized within the Preserve and also between each pair of communities recognized in several other floristic studies in north-central Florida (Abbott 1998). By comparing coefficient of community values of our coastal hydric hammock plots to those of our communities and of communities recognized elsewhere in the state, quantitative support may be found either for recognizing the plots as different floristically-based plant communities or for treating the plots as part of one highly variable community.

Most of the Preserve was found to be transitional, without any one of the canopy extremes, although the juniper and *Sabal*-dominated canopy type was most abundant. By the time eight good patches of the coastal hammock had been found, only a few of the other canopy types had been found. In the end, then, the first author searched for pine-dominated and mixed hardwood-dominated areas until roughly equal numbers of each had been found.

The 26 areas into which plots were placed had to meet specific canopy cover criteria. Coastal hammock areas had to have only *Juniperus virginiana* and *Sabal palmetto* forming over 90% of the canopy cover as determined by site inspection. Pine-dominated and mixed hardwood areas had to have pines or mixed hardwoods comprising over half the canopy cover. Any forested areas with infrequent to absent *J. virginiana* and *S. palmetto* were excluded from this portion of the study, as these areas usually represented swamp forest or mesic to scrubby flatwoods.

Once the plots were placed within the 26 subjectively chosen forest patches, a random number of paces along a random heading was used to establish the center point of a 100 m^2 plot, a circle with a 5.6 m radius. Every vascular plant species present in each plot was recorded (for raw data see Abbott 1998).

Since we already had chosen to follow FNAI community classification, we decided to just compare the similarity between our plant communities with the similarity between communities recognized by other workers in north-central Florida (Amoroso and Judd 1995; Easley and Judd 1993; Herring and Judd 1995; Tan and Judd 1995). This comparison would provide an estimate of the consistency between our community delimitations and those of other workers.

A comparative reference of similarity was created using coefficient of community values (Whittaker 1975) to quantify the floristic similarity between pairs of communities in our study, and between communities in other studies. The coefficient of community value was derived by doubling the number of species shared between two communities, then dividing by the following sum: twice the number of shared species plus the number of species present in each of the communities that is not shared with the second community. Ignoring any abiotic factors involved, this phenetic approach simply gave a measure of overall similarity based on a modification of the percentage of species shared between any two plant communities.

Even though the categorization of the plots was based on dominance of the canopy species, the plots within each canopy-type category were hardly identical in canopy composition. Seventeen canopy species were encountered: 16 in mixed hardwood areas, 7 in coastal hammock areas, and 6 in pine-dominated areas (see annotated list below). In calculating coefficient of community values for the plots, we noticed that some of the plots did not contain the characteristic canopy species. These small areas were just coincidental gaps in forest patches defined by the surrounding canopy. For example, a few mixed hardwood and pine-dominated plots actually lacked juniper and *Sabal,* although they were present nearby. *Quercus laurifolia* and *Q. vir-*

giniana were scattered throughout all of the canopy categories. Their massive size often conveyed an impression of dominance, but only along inland boundaries did they occur in stands with more than a few individuals. A few of the mixed hardwood areas were codominated by several individuals of only one or two hardwood species, but usually there were a few different species, with no single species appearing dominant. Areas dominated by pure stands of juniper and *Sabal* were extensive only nearest the coast. Inland, pine stands or scattered hardwoods could usually be seen nearby. Pines were almost never found as an understory member of areas not dominated by pines, although mature, relic pines were often found as isolated clumps of emergent trees in an otherwise non-pine-dominated canopy. Patches of pine-dominated canopy were only rarely found in the northern Preserve, and they were most common in the southernmost end of the southern Preserve.

Many understory species were found only under certain canopy extremes. A total of 124 understory species was documented in the 26 plots: 89 species in mixed hardwood areas, 40 of which were found only there; 53 species in coastal hammock areas, 10 of which were found only there; and 49 species in pine-dominated areas, 22 of which were found only there. Areas with mixed hardwoods, then, typically had a greater species richness than other areas, possibly reflecting the rarity or infrequency of flooding by salt water in these areas. Pine-dominated areas, although they had twice as many restricted understory species as coastal hammock areas, were roughly comparable to coastal hydric hammock in total species richness. Fifteen understory species were found under all three canopy types. Presumably, these species represent the most versatile and adaptive species. Nine species were found only in the mixed hardwood and pine-dominated areas, likely a reflection of salt intolerance. Twenty-five species were shared by mixed hardwood and coastal hammock areas, while only three species were shared by both coastal hammock and pine-dominated areas.

Species richness in an area was often related to factors not reflected by canopy differences. That is, environmental heterogeneity often affected the understory in ways not detectable in the canopy. Field observations while collecting these data indicated that several of the species were actually restricted to wet depressions, usually with standing water: 13 species in mixed hardwood areas, 11 in mixed hardwood and coastal hammock areas, and 5 in coastal hammock areas. Thus, in the mixed hardwood and coastal hammock areas, species richness was enhanced by environmental heterogeneity due to scattered freshwater pools. Field observations also indicated that some of the coastal pine-dominated areas had been invaded by salt marsh species. Nine salt marsh species were present in association with what appeared to be a relict canopy, with little or no regeneration of canopy species. This situation is very similar to the pattern described by Williams et al. (1997) for relict patches of *Sabal palmetto* and *Juniperus virginiana.*

Seventy-two of the total 124 understory species were restricted to just one canopy extreme in this study, suggesting a possible association between various understory species and different canopy types. However, 97 species were present in three or fewer plots, with 51 species present in one plot only. This reflects the patchy nature of the Preserve's forest and the relative scarcity of most plant species. This high number of species restricted to only one (to three) plot(s) resulted in an inadequate sample size for determining whether or not there was a significant correlation between the different understory species and the different canopy extremes. Given the vast area of the Preserve, the amount of area covered by the plots was extemely small. Thus, any patterns in species distribution should not be considered as necessarily reflective of all of the Preserve's coastal hydric hammock.

The level of distinctiveness between plant communities recognized in this study corresponded to that of most communities recognized by other workers (Table 1; Abbott 1998). All of the plant communities in this study had coefficient of community values ($\times$ 100) less than 30, as did almost all of the plant communities recognized by others.

The coastal hydric hammock plots were all more similar to each other than our plant communities were to each other (i.e., they had higher coefficient of community values than were found between any of the plant communities recognized herein; Abbott 1998). These similarity data support the decision to treat the plots as variants of a single broadly defined community, coastal hydric hammock. Since there were no readily discernable differences in hydrology, microtopography, or soil depth or type between the plot areas, there was also no reason to recognize the canopy variants as nonfloristically based plant communities.

Table 1. Coefficient of community values (× 100) calculated for the Waccasassa Bay State Preserve, an estimate of similarity based on shared plant species. A. Plots in all communities. B. Plots in Coastal Hydric Hammock. C. Plots in Coastal Hydric Hammock, factoring out the Wet Depression species and Tidal Marsh species.

	FL	CH	SW	FP
A.				
Mesic to Scrubby Flatwoods (FL)				
Coastal Hydric Hammock (CH)	26			
Basin Swamp (SW)	20	29		
Freshwater Pools and Wet Depressions (FP)	7	10	19	
Tidal Marsh (TM)	10	15	14	20

	PC	JC
B.		
Pine-dominated Canopy (PC)		
Juniper & *Sabal*-dominated Canopy (JC)	39	
Mixed Hardwood-dominated Canopy (MC)	38	60

	PC	JC
C.		
Pine-dominated Canopy (PC)		
Juniper & *Sabal*-dominated Canopy (JC)	49	
Mixed Hardwood-dominated Canopy (MC)	49	62

FLORISTIC METHODS AND RESULTS

Field work was conducted by the first author in the Waccasassa Bay State Preserve from April 1996 to December 1997. Topographic maps, soil maps, and aerial photos were used to ensure adequate, representative coverage of plant community variation. A compass and a handheld global positioning unit greatly facilitated field-efficiency and accuracy, especially given the lack of trails, the large area, and the relative inaccessibility of much of the Preserve. Since species richness was generally greatest away from the coast, it was often convenient and most informative to walk the inland boundaries, when marked, making occasional transects toward the coast. On two occasions, an airboat was used to survey the outer limits of the tidal marsh and island hammocks. Several canoe trips were also made into the tidal marsh, in addition to numerous visits on foot.

Representative vouchers were deposited in the University of Florida Herbarium (FLAS), and a partial duplicate set at Selby

Botanical Gardens Herbarium (SEL). The primary references used for identification of vascular plants were Wunderlin (1982) and Clewell (1985), although Cronquist (1980), Godfrey and Wooten (1979, 1981), Hall (1978), Isely (1990), and Long and Lakela (1976) were also used. Current taxonomic revisions were consulted whenever possible, as cited on the species list.

A total of 576 vascular species and subspecific taxa was documented from 353 genera and 116 families. There was 1 lycopsid, 12 ferns, 1 cycad, 4 conifers, and 555 angiosperms, 178 of which were monocots. Sixty-nine nonindigenous species were documented from the Preserve, most of them from a single right-of-way access road, Fiber Factory Road. Seventy-three plants were Levy County records, having never been documented previously in the county according to Wunderlin et al. (1997). Given that larger numbers of species have been found in much smaller areas in Florida (e.g., Herring and Judd 1995), and that many of the Preserve's species have actually only been found in the very limited ruderal areas, it seems rather clear that the Preserve is not very species-rich. This is likely a reflection of its position as an extreme coastal strip.

The families with the greatest representation, followed by number of species, are Asteraceae (77), Poaceae (75), Cyperaceae (49), Fabaceae (36), Scrophulariaceae (14), Apiaceae (11), Polypodiaceae (10), Rubiaceae (10), Malvaceae (10), and Lamiaceae (9). The largest genera are *Cyperus* (15), *Panicum* (11), *Carex* (10), *Juncus* (8), *Paspalum* (8), *Eupatorium* (7), *Quercus* (7), *Smilax* (7), *Ipomoea* (6), *Rhynchospora* (6), and *Solidago* (6).

No vouchers were found for any of the previous studies, principally zoological, in the Gulf Hammock area (Jennings 1951; Pearson 1951; Swindell 1949), although most of their reported plant species, once nomenclature is updated, are documented herein or are to be expected in the area. There are also no vouchers from most of the limited, previous botanical work in the Waccasassa Bay State Preserve, although an unpublished species list exists for the Preserve. This unofficial list, on file at the office of the Division of Recreation and Parks, District 2, in Gainesville, Florida, was largely based on field identifications during 1986 and 1987 by Dr. David Hall. According to letters on file at the district office, several of his determinations were actually made in the FLAS herbarium from material sent in by Don Younker, a district employee at that time.

Personal communication with both D. Hall and D. Younker has convinced us that they were always aware of being within the Preserve boundaries and that the identifications were rarely in doubt. We believe that the species not recollected by us were in the Preserve and may still be there in rare tiny pockets, mostly in scrubby flatwoods at the southern end of the Preserve. Thus, for completeness and for future reference, any species whose name was clearly traceable to the work of David Hall, yet was not collected by us (41 species total), was included in the species list but was not used in any other way in the analyses or descriptions. Any species on the previous unofficial list from the Preserve that was not documented by us, or listed in the Hall and Younker correspondences on file, was excluded, since, in addition to the lack of vouchers, there was no indication from where or from whom the name came. The only vascular plant specimens found from previous work in the Preserve are those of the second author, who made a couple of casual collecting trips into the area in 1980 and 1994. All of the species found by him were found again by the first author during the course of this study.

Species of special concern or interest. Many species are of interest in the area as they are either at or near the limit of their natural ranges in Florida (72 spp.), are notably disjunct (13 spp.), have a very restricted range in Florida (5 spp.), are endemic or nearly endemic to Florida (16 spp.), or are listed as commercially exploited, of special concern, rare, threatened, or endangered in Florida (23 spp.). An on-line atlas of the vascular flora of Florida was used for determining species ranges (Wunderlin et al. 1997). For our purposes, species at their distributional limit reach Levy County from the north or south but do not extend any farther. Species near their distributional limit do not extend beyond two counties along the Gulf coast to the north or south of Levy County. A listing of species at or near their distributional limits is available in Abbott (1998). The five species with very restricted ranges in Florida found in the Preserve are *Leitneria floridana, Phaseolus smilacifolius, Phyllanthus liebmannianus* ssp. *platylepis, Spigelia loganioides,* and *Ulmus crassifolia.* Sixteen Florida endemics or near-endemics were documented in the Preserve: *Aristida patula, Berlandiera subacaulis, Campanula floridana, Carex vexans, Coreopsis leavenworthii, Eupatorium mikanioides, Lobelia feayana, Pluchea longifolia, Rhynchosia michauxii, Scutel-*

laria arenicola, and *Vicia floridana* are endemic, while *Ageratina jucunda* and *Panicum dichotomum* var. *breve* are nearly endemic to Florida (Muller et al. 1989).

Twenty-three species were found that have been listed as either commercially exploited, of special concern, rare, threatened, or endangered in Florida (Table 2) by Coile (1993), Kral (1983), and Ward (1979). Many of the listed bromeliads, ferns, and orchids are actually quite common in Florida. Perhaps some of these species would be better treated as potentially commercially exploited, if protection is indeed necessary. No federally-listed protected species were found within the Waccasassa Bay State Preserve (Wood 1996).

ANNOTATED LIST OF VASCULAR PLANTS

The vascular plant species inventoried for Waccasassa Bay State Preserve are listed in Appendix 1. Some angiosperm family names and/or circumscriptions here deviate from Wunderlin (1982); in such cases references are provided and the traditional family names are still included and are cross-referenced to facilitate use of the species list.

The species list is arranged alphabetically by family, genus, and species, within the context of the larger monophyletic groups of lycopsids, ferns, cycads, conifers, and angiosperms. Nomenclature follows Wunderlin (1982, 1998), unless otherwise indicated in the species list, and Wunderlin (1998) was used for determining exotic status. Forty-one species not found by the first author but reported by David Hall during the 1980s are also listed here. Most of Hall's taxa were reportedly seen in the southernmost portion of the Preserve, and, if still present, can be considered rare.

The plant communities in which the species occurred are tidal marsh, coastal hydric hammock, basin swamp, mesic to scrubby flatwoods, freshwater pools and wet depressions, and ruderal areas. There are obviously many transitional areas, and most species, especially the more abundant ones, can be found along the edges of, or in isolated patches within, adjacent communities. Such transitional areas are not reflected in the species list. Rather, multiple communities are listed only when a species was observed to occur as a distinctive element in several communities. For example, *Juncus roemerianus*, typically a salt marsh species,

Table 2. Status classification of vascular plants in the Waccasassa Bay State Preserve that are listed as commercially exploited (CE), of special concern (S), rare (R), threatened (T), or endangered (E) in Florida (Coile 1993; Kral 1983; Ward 1979).

Species	Status and Reference		
	Kral	Coile	Ward
Acrostichum danaefolium		T	
Asplenium platyneuron		T	
Avicennia germinans			S
Dryopteris ludoviciana		T	
Epidendrum conopseum		T	
Hexalectris spicata		E	
Ilex cassine		CE	
Leitneria floridana		T	R
Lobelia cardinalis		T	
Malaxis spicata		T	
Osmunda cinnamomea		CE	
Phyllanthus liebmannianus ssp. *platylepis*		E	R
Rhapidophyllum hystrix		CE	T
Sabal minor		T	
Sageretia minutiflora	E		
Selaginella apoda		T	
Smilax smallii			T
Spigelia loganioides		E	R
Thelypteris kunthii		T	
Thelypteris palustris		T	
Tillandsia bartramii		T	
Ulmus crassifolia			R
Zamia floridana		CE	T

could sometimes be found inland. Mostly this was in association with other typical salt marsh species, and such sites were considered as transitional patches of tidal marsh. In a few areas, however, *J. roemerianus* occurred in association with more freshwater species, without associated salt marsh species. In these areas, *J. roemerianus* was treated as a distinctive element of the freshwater pools. Finally, essentially every species within the Preserve could be found along or near a ruderal area. Our attempt here was to indicate only the species restricted to ruderal areas and the species that usually occurred in clearings or forest gaps of adjacent communities, as well as ruderal areas.

As pointed out by Amoroso and Judd (1995), the relative abundance of a plant is subject to its reproductive status, seasonal variation, population changes from year to year, and the judgement and acuity of the researcher. Thus, abundance values reflect the first author's subjective estimate of a plant's frequency, especially in comparison to associated species or related species. This is especially true for the basin swamp and mesic to scrubby flatwoods communities, because both are rare within the Preserve, occupying only a very few small areas, and any plant restricted to either of these communities is automatically rare in the whole Preserve. For all the other communities, a numerical scale (Appendix 1; modified from Thompson and Wade 1991) was used as a guide for abundance values.

LIST OF CHAROPHYTES, LIVERWORTS, MOSSES, AND MACROLICHENS

Two charophytes, 24 liverworts, 29 mosses, and 43 macrolichens were documented from the Waccasassa Bay State Preserve (Appendix 2). Numerous other mosses and macrolichens have been reported for Levy County and may eventually be found within the Preserve (see Amoroso and Judd 1995; Breen 1963; Moore 1968; also collections at FLAS). In the list of taxa, charophytes, liverworts, mosses, and macrolichens are presented separately, and within each list, taxa are arranged alphabetically by family and species.

Although bryophyte family relationships have been recently investigated by Buck and Vitt (1986) we simply followed the classification schemes used by the authors of the following keys and floras. Charophytes were identified using Wood (1967). Breil (1970) was used to identify liverworts, except for *Frullania cobrensis* (Griffin and Breil 1982). Breen (1963) and Crum and Anderson (1981) were used to identify mosses, with nomenclature following the latter, unless otherwise indicated. Macrolichens were identified using Moore (1968), Hale (1979), and Harris (1995), although nomenclature follows Esslinger and Egan (1995). Crustose lichens were not included in this inventory, although one or more crustose lichens are present in virtually all of the lichen voucher specimens. Some of the more distinctive crustose genera, *Haematomma, Pertusaria, Buellia*-like, and *Graphis*-like entities, were observed to be very common in the Preserve, especially on small branches in open sunny areas.

Bryophytes and macrolichens respond to microhabitat features on a scale much smaller than that of vascular plant communities.

Moisture and light intensity are undoubtedly the most important factors controlling bryophyte and lichen distribution within the landscape. Thus, a water-loving moss like *Fissidens cristatus* may be most abundant in the wettest plant community, such as swamp, but it can also be found in the drier flatwoods community, given a suitable moisture regime, such as in a crevice at the shaded base of a tree trunk. Lichens, such as many *Cladonia* spp., that are typically soil-dwelling, can be found on tree trunks under favorable conditions.

In general, mesic inland portions of the Preserve supported the greatest number of bryophytes, with a reduction in species richness and abundance towards the coast. The most common and widespread bryophytes were: *Cheilolejeunea* spp., *Fissidens cristatus, Isopterygium tenerum, Lejeunea* spp., *Leucobryum albidum,* and *Syrrhopodon incompletus.* The only bryophyte found in tidal marsh was *Frullania kunzei,* on bare branches of *Lycium carolinianum.* Soil-dwelling bryophytes were uncommon in the Preserve and were largely restricted to open sand in flatwoods (e.g., *Bryum pseudocapillare, Ditrichum pallidum*), a few raised hummocks in swamps (e.g., *Aneura pinguis, Odontoschisma prostratum, Pallavicinia lyellii*), and raised areas near the base of trees (most taxa, at least in places). Frequent flooding in the Preserve likely limits the ground diversity, as well as impacting species composition on fallen branches, logs, and tree bases. The only bryophytes consistently found on moist limestone rocks were *Barbula agraria, B. cancellata,* and *Marchantia domingensis.* Typically, in other areas, a succession of different suites of species are associated with the transition from living trunks to fallen logs to decomposing debris, but no strong successional patterns were seen by the first author within the Preserve. Certain species, such as *Leucobryum albidum, Octoblepharum albidum,* and *Syrrhopodon incompletus* were almost always restricted to erect *Sabal palmetto* trunks. Other species, such as *Cryphaea glomerata, Forsstroemia trichomitria, Leucodon julaceus,* and *Radula australis,* as well as most Frullaniaceae and Lejeuneaceae, were found primarily on living hardwood and juniper trunks. Most of the remaining bryophyte species seemed to grow anywhere that was moist enough: bark, fallen branches, logs, and soil.

Of the lichens, *Leptogium, Parmotrema* (and other similar-looking *Parmelia* segregates), and *Usnea* species were the most visually dominant and abundant. In shaded forests, lichens such as *Collema, Leptogium,* and *Pseudoparmelia,* could be found on bark and over bryophytes, but most lichens were growing on trunks in open areas or on canopy branches.

Both of the charophytes were submerged aquatics, with the only other true aquatic being the floating liverwort, *Riccia fluitans.*

Although no specific numerical values were assigned, largely due to identification uncertainty in the field, subjective abundance values were used to indicate relative frequency of each charophyte and bryophyte species. Rare species (R) were not seen more than once or twice. Infrequent species (I) were seen a few times, while occasional species (O) were seen several times. Frequent species (F) were scattered throughout the Preserve, but were not consistently common. Abundant species (A) were very common throughout the forested Preserve. Bryophytes that are difficult to identify in the field were very likely more common than indicated here (i.e., the accuracy of abundance values here is a function of how distinctive the species were in the field). There was definitely a pronounced bias toward bryophytes within two meters of the ground. No abundance values are given here for macrolichens, as accurate species determinations were only had once detailed laboratory inspection and chemical tests were carried out. Of the lichens, only some individuals of the *Cladonia* species were occasionally found on the ground. All other lichens were found on tree trunks and branches.

ACKNOWLEDGMENTS. Without the assistance of Dr. Dana Griffin, we could not have included charophytes, bryophytes, or macrolichens in this inventory. Numerous discussions with Dr. Kimberlyn Williams helped our understanding of ecological principles and contributed to the development of the quantitative floristics portion of this thesis. Dr. Francis "Jack" Putz is also thanked for advice on ecological field techniques. We thank herbarium staff, Kent Perkins and Trudy Lindler, for their assistance with technical herbarium details. Gerald "Stinger" Guala is thanked for his assistance with plant identification, especially grasses. Personnel of the Florida Division of Recreation and Parks, District 2, are thanked for their support. Kelly MacPherson and Dan Pearson were especially helpful. Harry Mitchell and Nikki Makruski provided field assistance and keys to access gates. This study was conducted in partial fulfillment of requirements for the M.S. degree of the first author.

LITERATURE CITED

ABBOTT, J. R. 1998. Floristic inventory of the Waccasassa Bay State Preserve, Levy County, Florida. M.S. thesis, Univ. Florida, Gainesville, FL.

ADAMS, R. P. 1986. Geographic variation in *Juniperus silicicola* and *Juniperus virginiana* of the southeastern United States: Multivariate analysis of morphology and terpenoids. Taxon 35: 61–75.

ALLRED, K. W. 1986. Studies in the *Aristida* (Gramineae) of the southeastern United States. IV. Key and conspectus. Rhodora 88: 367–387.

AMOROSO, J. L. AND W. S. JUDD. 1995. A floristic study of the Cedar Key Scrub State Reserve, Levy county, Florida. Castanea 60: 210–222.

ANDREWS, E. G. AND M. D. WINDHAM. 1993. *Pleopeltis,* pp. 324–327. *In*: Flora of North America Editorial Committee, eds. 1993+. Flora of North America North of Mexico, Vol. 2: Pteridophytes and Gymnosperms. Oxford Univ. Press, NY.

BRADLEY, T. R. 1975. Hybridization between *Triodanis perfoliata* and *Triodanis biflora* (Campanulaceae). Brittonia 27: 110–114.

BREEN, R. S. 1963. Mosses of Florida. Univ. Press Florida, Gainesville, FL.

BREIL, D. A. 1970. Liverworts of the mid-gulf coastal plain. Bryologist 73: 409–491.

BUCK, W. R. AND H. CRUM. 1990. An evaluation of familial limits among the genera traditionally aligned with the Thuidiaceae and Leskeaceae. Contr. Univ. Michigan Herb. 17: 55–69.

——— AND D. H. VITT. 1986. Suggestions for a new familial classification of pleurocapous mosses. Taxon 35: 21–60.

BURKHALTER, R. E. 1992. The genus *Nyssa* (Cornaceae) in North America: A revision. Sida 15: 323–342.

BURNSON, T., J. L. SHOEMYEN, J. R. CAMERON, K. B. WEBSTER, L. C. OXFORD, JR., R. CERYAK, R. E. COPELAND, C. J. LEADON, AND P. BATCHELDER. 1984. Suwannee River Water Management District, pp. 218–232. *In*: Fernald, E. A. and D. J. Patton, eds., Water Resources Atlas of Florida. Univ. Press Florida, Gainesville, FL.

CAMPBELL, C. S. 1983. Systematics of the *Andropogon virginicus* complex (Gramineae). J. Arnold Arbor. 64: 171–254.

CANTINO, P. D. 1992. Evidence for a polyphyletic origin of the Labiatae. Ann. Missouri Bot. Gard. 79: 361–379.

CAULKINS, D. B. AND R. WYATT. 1990. Variation and taxonomy of *Phytolacca americana* and *P. rigida* in the southeastern United States. Bull. Torrey Bot. Club 117: 357–367.

CHEN, E. AND J. F. GERBER. 1990. Climate, pp. 11–34. *In*: Myers, R. L. and J. J. Ewel, eds., Ecosystems of Florida. Univ. Central Florida Press, Orlando, FL.

CLEMANTS, S. E. 1992. Chenopodiaceae and Amaranthaceae of New York State. New York State Mus. Bull. #485, State Education Dept., Albany, NY.

Clewell, A. F. 1985. Guide to the vascular plants of the Florida panhandle. Florida State Univ. Press, Tallahassee, FL.

Coile, N. C. 1993. Florida's endangered and threatened plants. Bureau of Entomology, Nematology, and Plant Pathology—Botany Section, contrib. #26. Florida Dept. Agric. and Consumer Services, Div. Plant Industry, Gainesville, FL.

Conover, C. S., J. J. Geraghty, and G. G. Parker, Sr. 1984. Groundwater, pp. 36–53. *In*: Fernald, E. A. and D. J. Patton, eds., Water Resources Atlas of Florida. Univ. Press Florida, Gainesville, FL.

Cronquist, A. 1980. Vascular Flora of the Southeastern United States, Vol. 1: Asteraceae. Univ. North Carolina Press, Chapel Hill, NC.

Crum, H. A. and L. E. Anderson. 1981. Mosses of Eastern North America, 2 Vols. Columbia Univ. Press, NY.

Dahlgren, R. M. T., H. T. Clifford, and P. F. Yeo. 1985. The Families of the Monocotyledons: Structure, Evolution, and Taxonomy. Springer-Verlag, Berlin.

Easley, C. and W. S. Judd. 1993. Flora of Little Talbot Island, Duval County, Florida. Castanea 58: 162–177.

Eckenwalder, J. E. 1976. Re-evaluation of Cupressaceae and Taxodiaceae: A proposed merger. Madroño 23: 237–256.

———. 1980. Taxonomy of the West Indian cycads. J. Arnold Arbor. 61: 701–722.

Eiten, G. 1963. Taxonomy and regional variation of *Oxalis* section *Corniculatae*, 1: Introduction, keys and synopsis of the species. Amer. Midl. Naturalist 69: 257–309.

Endress, M. E., B. Sennblad, S. Nilsson, L. Civeyrel, M. W. Chase, S. Huysmans, E. Grafsroem, and B. Bremer. 1996. A phylogenetic analysis of Apocynaceae *sensu strictu* and some related taxa in Gentianales: A multidisciplinary approach. Opera Bot. Belg. 7: 59–102.

Esslinger, T. L. and R. S. Egan. 1995. A sixth checklist of the lichen-forming, lichenicolous, and allied fungi of the continental United States and Canada. Bryologist 98: 467–549.

Eyde, R. H. 1988. Comprehending *Cornus*: Puzzles and progress in the systematics of the dogwoods. Bot. Rev. 54: 233–351.

Fay, M. F. and M. W. Chase. 1996. Resurrection of Themidaceae for the *Brodiaea* alliance, and recircumscription of Alliaceae, Amaryllidaceae, and Agapanthoideae. Taxon 45: 441–451.

Fernando, E. S., P. A. Gadek, and C. J. Quinn. 1995. Simaroubaceae, an artificial construct; evidence from *rbc*L sequence variation. Amer. J. Bot. 82: 92–103.

Florida Natural Areas Inventory and Florida Department of Natural Resources (FNAI and FDNR). 1990. Guide to the natural communities of Florida, February Issue. Tallahassee, FL.

French, J. C., M. G. Chung, and Y. K. Hur. 1995. Chloroplast DNA phylogeny of the Ariflorae, pp. 255–275. *In*: P. J. Rudall, P. J. Cribb, D. F. Cutler, and C. J. Humphries, eds., Monocotyledons: Systematics and Evolution, 2 vols. Royal Botanic Garden, Kew, England.

Gannon, M. 1993. Florida: A Short History. Columbus Quincentenary Series. Univ. Press Florida, Gainesville, FL.

———, ed. 1996. The New History of Florida. Univ. Press Florida, Gainesville, FL.

George, P. S., ed. 1989. A Guide to the History of Florida. Greenwoods Press, Westport, CT.

Godfrey, R. K. and J. W. Wooten. 1979. Aquatic and Wetland Plants of the Southeastern United States. Monocotyledons. Univ. Georgia Press, Athens, GA.

——— and ———. 1981. Aquatic and Wetland Plants of the Southeastern United States. Dicotyledons. Univ. Georgia Press, Athens, GA.

Griffin, D. and D. A. Breil. 1982. Notes on *Frullania cobrensis* Gott. ex Steph. in Cuba and Florida. Bryologist 85: 435–441.

Grudzinskaja, I. A. 1967. [translated by K. Rosneck, 1990] Ulmaceae and reasons for distinguishing Celtidoideae as a separate family Celtidaceae Link. Bot. Zhurn. (Leningrad) 52: 1723–1749.

Gunter, J., V. Brooks, B. Porter, and R. Thompson. 1992. Comprehensive Shellfish Harvesting Area Survey of Waccasassa Bay, Levy County, Florida. Florida Dept. Nat. Resources, Tallahassee, FL.

Hale, M. E. 1979. How to Know the Lichens, 2nd ed. Wm. C. Brown Co., Publ., Dubuque, IA.

Hall, D. W. 1978. The Grasses of Florida. Ph.D. dissertation, Univ. Florida, Gainesville, FL. Univ. Microfilms International #7913279, Ann Arbor, MI.

Harris, R. C. 1995. More Florida Lichens, Including the 10 Cent Tour of the Pyrenolichens. Published by the author, Bronx, NY.

Hart, J. A. 1987. A cladistic analysis of the conifers: Preliminary results. J. Arnold Arbor. 68: 269–307.

——— and R. A. Price. 1990. The genera of Cupressaceae (including Taxodiaceae) in the southeastern United States. J. Arnold Arbor. 71: 275–322.

Herndon, A. 1992a. The genus *Hypoxis* (Hypoxidaceae) in Florida. Fl. Sci. 55: 45–55.

———. 1992b. Nomenclatural notes on North American *Hypoxis* (Hypoxidaceae). Rhodora 94: 43–47.

Herring, B. and W. S. Judd. 1995. A floristic study of Ichetucknee Springs State Park, Suwannee and Columbia Counties, Florida. Castanea 60: 318–369.

Hine, A. C. and D. F. Belknap. 1986. Recent geological history and modern sedimentary processes of the Pasco, Hernando and Citrus County coastline: West-central Florida. Florida Sea Grant Rep. 79, Gainesville, FL.

Ho, F. P. and R. J. Tracey. 1975. Storm tide frequency analysis for the Gulf coast of Florida, from Cape San Blas to St. Petersburg Beach. Office of Hydrology, National Weather Service, Silver Spring, MD.

Isely, D. 1990. Vascular Flora of the Southeastern United States, Vol. 3, Part 2: Leguminosae. Univ. North Carolina Press, Chapel Hill, NC.

Iverson, R. L. and H. F. Bittaker. 1986. Seagrass distribution and abundance in eastern Gulf of Mexico coastal waters. Est. Coast. Shelf Sci. 22: 577–602.

Jansen, R. K. 1985. The systematics of *Acmella* (Asteraceae-Heliantheae). Syst. Bot. Monogr. 8: 1–115.

JENNINGS, W. L. 1951. A Study of the Life History and Ecology of the Gray Squirrel (*Sciurus c. carolinensis* Gmelin) in Gulf Hammock. M.S. thesis, Univ. Florida, Gainesville, FL.

JENSEN, S. R. 1992. Systematic implications of the distribution of iridoids and other chemical compounds in the Loganiaceae and other families of the Asteridae. Ann. Missouri Bot. Gard. 79: 284–302.

JORDAN, C. L. 1984. Florida's weather and climate: Implications for water, pp. 18–35. *In*: Fernald, E. A. and D. J. Patton, eds., Water Resources Atlas of Florida. Univ. Press Florida, Gainesville, FL.

JUDD, W. S. AND S. R. MANCHESTER. 1997. Circumscription of Malvaceae (Malvales) as determined by a preliminary cladistic analysis of morphological, anatomical, palynological, and chemical characters. Brittonia 49: 384–405.

———, R. W. SANDERS, AND M. J. DONOGHUE. 1994. Angiosperm family pairs: Preliminary phylogenetic analyses. Harvard Pap. Bot. 5: 1–51.

KADEREIT, J. W., F. R. BLATTNER, K. B. JORK, AND A. SCHWARZBACH. 1994. Phylogenetic analysis of the Papaveraceae *sensu lato* (including Fumariaceae, Hypecoaceae, and *Pteridophyllum*) based on morphological characters. Bot. Jahrb. Syst. 116: 361–390.

———, ———, ———, AND ———. 1995. The phylogeny of the Papaveraceae *sensu lato*: Morphological, geographical and ecological implications. Pl. Syst. Evol., Suppl. 9: 133–145.

KRAL, R. 1983. A Report on Some Rare, Threatened or Endangered Forest-related Vascular Plants of the South, 2 vols. USDA Forest Service Tech. Publ. R8-TP2, Atlanta, GA.

———. 1997. Annonaceae, pp. 11–20. *In*: Flora of North America Editorial Committee, eds. 1993+. Flora of North America North of Mexico, Vol. 3: Magnoliophyta. Oxford Univ. Press, NY.

LANDRY, G. P. 1993. Zamiaceae, pp. 347–349. *In*: Flora of North America Editorial Committee, eds. 1993+. Flora of North America North of Mexico, Vol. 2: Pteridophytes and Gymnosperms. Oxford Univ. Press, NY.

LANE, M. A. AND R. L. HARTMAN. 1996. Reclassification of North American *Haplopappus* (Compositae: Astereae) completed: *Rayjacksonia* gen. nov. Amer. J. Bot. 83: 356–370.

LOCONTE, H., L. M. CAMPBELL, AND D. W. STEVENSON. 1995. Ordinal and familial relationships of ranunculid genera. Pl. Syst. Evol., Suppl. 9: 99–118.

LONG, R. W. AND O. LAKELA. 1976. A Flora of Tropical Florida. Banyan Books, Miami, FL.

MATTER, R. A. 1990. Pre-Seminole Florida: Spanish Soldiers, Friars, and Indian Missions, 1513–1763. Garland Publishing, Inc., NY.

MAYO, S. J., J. BOGNER, AND P. BOYCE. 1995. The Arales, pp. 277–286. *In*: P. J. Rudall, P. J. Cribb, D. F. Cutler, and C. J. Humphries, eds., Monocotyledons: Systematics and Evolution. Royal Botanic Gardens, Kew, England.

MILANICH, J. T. 1994. Archaelogy of Precolumbian Florida. Univ. Press Florida, Gainesville, FL.

———. 1995. Florida Indians and the Invasion from Europe. Univ. Press Florida, Gainesville, FL.

MOORE, B. 1968. The macrolichen flora of Florida. Bryologist 71: 161–266.

MORGAN, D. R. AND D. E. SOLTIS. 1993. Phylogenetic relationships among members of Saxifragaceae *sensu lato* based on *rbc*L sequence data. Ann. Missouri Bot. Gard. 80: 631–660.

MULLER, J. W., E. D. HARDIN, D. R. JACKSON, S. E. GATEWOOD, AND N. CAIRE. 1989. Summary report on the vascular plants, animals, and plant communities endemic to Florida. Florida Game and Freshwater Fish Commission, Nongame Wildlife Progr. Tech. Rep. No. 7, Tallahassee, FL.

NACZI, R. F. 1993. *Carex brysonii* and *Carex godfreyi*, new species of *Carex* section *Griseae* (Cyperaceae) from the southeastern United States. Contr. Univ. Michigan Herb. 19: 195–205.

NEILL, W. T. 1951. A new subspecies of salamander, genus *Pseudobranchus*, from the Gulf Hammock region of Florida. Publ. Research Div., Ross Allen's Reptile Institute, Silver Springs, FL. Vol. 1: 39–46.

NESOM, G. L. 1990. Taxonomic status of *Gamochaeta* (Asteraceae, Inuleae) and the species of the United States. Phytologia 68: 186–198.

PEARSON, P. G. 1951. Mammals of Gulf Hammock, Levy County, Florida. M.S. thesis, Univ. Florida, Gainesville, FL.

PENNINGTON, T. D. 1991. The genera of Sapotaceae. Royal Botanic Gardens, Kew, Richmond, Surrey, UK and New York Botanical Gardens, NY.

PRUSKI, J. F. 1996. Compositae of the Guayana Highland—XI. *Tuberculocarpus* gen. nov. and some other Ecliptinae (Heliantheae). Novon 6: 404–418.

PRYER, K. M., A. R. SMITH, AND L. E. SKOG. 1995. Phylogenetic relationships of extant ferns based on evidence from morphology and *rbc*L sequences. Amer. Fern J. 85: 203–282.

RUPERT, F. R. 1988. Geology and Geomorphology of Levy County, Florida. Florida Geological Survey Open File Rep. #19, Tallahassee, FL.

SCHOLZ, U. 1981. Monographie der gattung *Oplismenus* (Gramineae). Phanerogamarum Monographiae Tomus XVIII. J. Cramer, Vaduz, Germany.

SLABAUGH, J. D., A. O. JONES, W. E. PUCKETT, AND J. N. SCHUSTER. 1996. Soil survey of Levy County, Florida. U.S.D.A. Nat. Resources Conservation Serv.

STEVENSON, D. W. 1991. The Zamiaceae in the Southeastern United States. J. Arnold Arbor., Suppl. Series 1: 367–384.

SUWANNEE RIVER WATER MANAGEMENT DISTRICT (SRWMD). 1991. Waccasassa river system: Surface water improvement and management plan. Unpubl. document.

SWINDELL, D. E., JR. 1949. Plant Communities and Other Factors Affecting the Deer and Turkey Populations in Gulf Hammock. M.S. thesis, Univ. Florida, Gainesville, FL.

TAN, B. H. AND W. S. JUDD. 1995. A floristic inventory of O'Leno State Park and Northeast River Rise State Preserve, Alachua and Columbia Counties, Florida. Castanea 60: 141–165.

TANNER, W. F. 1996. Natural Environment, pp. 12–77. *In*: Fernald, E. A. and E. D. Purdum, eds., Atlas of Florida, rev. ed. Univ. Press Florida, Gainesville, FL.

TEBEAU, C. W. 1971. A History of Florida. Univ. Miami Press, Coral Gables, FL.

Thompson, R. L. and G. L. Wade. 1991. Flora and vegetation of a 12-year-old coal surface-mined area in Rockcastle County, Kentucky. Castanea 56: 99–116.

Thompson, S. K. S. 1980. Hammock Vegetation in the Northern Gulf Hammock Region of Florida. M.S. thesis. Florida State Univ., Tallahassee, FL.

Thorne, R. F. 1983. Proposed new alignments in the Angiosperms. Nordic J. Bot. 3: 85–117.

———. 1992. Classification and geography of the flowering plants. Bot. Rev. 58: 225–347.

Vernon, R. O. 1951. Geology of Citrus and Levy Counties, Florida. Florida Geol. Survey Geol. Bull. 33: 256.

Vince, S. W., S. R. Humphrey, and R. W. Simons. 1989. The Ecology of Hydric Hammocks: A Community Profile. U.S. Fish Wildl. Serv. Biol. Rep. 85(7.26).

Waldron, P. W., et al. 1984. Southwest Florida Water Management District, pp. 178–197. *In*: Fernald, E. A. and D. J. Patton, eds., Water Resources Atlas of Florida. Univ. Press Florida, Gainesville, FL.

Ward, D. B. 1976. *Mitracarpus* (Rubiaceae), a genus new to Florida and Eastern North America. Rhodora 78: 674–681.

———. 1979. Rare and Endangered Biota of Florida. Univ. Press Florida, Gainesville, FL.

WBSPR. 1997. Waccasassa Bay State Preserve Report. Information on file at District 2 Office, Gainesville, FL.

Webb, S. D. 1990. Historical biogeography, pp. 70–102. *In*: Myers, R. L. and J. J. Ewel, eds., Ecosystems of Florida. Univ. Central Florida Press, Orlando, FL.

Webster, R. D. 1988. Genera of the North American Paniceae (Poaceae: Panicoideae). Syst. Bot. 13: 576–609.

Whittaker, R. H. 1975. Communities and Ecosystems, 2nd ed. Macmillan Publ. Co., NY.

Williams, K., K. C. Ewel, R. P. Stumpf, F. E. Putz, and T. W. Workman. 1997. Sea-level rise and coastal forest retreat on the west coast of Florida, U.S.A. Unpubl. manuscript.

Windham, M. D. 1993. New taxa and nomenclatural changes in the North American fern flora. Contr. Univ. Michigan Herb. 19: 31–61.

Wolfe, S. H., ed. 1990. An ecological characterization of the Florida Springs Coast: Pithlachascotee to Waccasassa Rivers. U.S. Fish Wildl. Serv. Biol. Rep. 90(21).

Wood, D. A. 1996. Florida's endangered species, threatened species, and species of special concern: Official lists. Bureau of Nongame Wildlife, Division of Wildlife, Florida Game and Fresh Water Fish Commission, Tallahassee, FL.

Wood, R. D. 1967. Charophytes of North America. Stella's Printing, West Kingston, RI.

Wunderlin, R. P. 1982. Guide to the Vascular Plants of Central Florida. Univ. Press Florida, Gainesville, FL.

———. 1998. Guide to the Vascular Plants of Florida. Univ. Press Florida, Gainesville, FL.

———, B. F. Hansen, and E. L. Bridges. 1997. Atlas of Florida vascular plants. [available at: http://www.usf.edu/~isb/projects/atlas/atlas.html]

Zuloaga, F. O. 1986. Systematics of New World species of *Panicum* (Poaceae: Paniceae), pp. 287–306. *In*: Soderstrom, T. R., K. W. Hilu, C. S. Campbell, and M. E. Barkworth, eds., Grass Systematics and Evolution. Smithsonian Institution Press, Washington, DC.

APPENDIX 1

ANNOTATED LIST OF VASCULAR PLANTS OF WACASASSA BAY STATE PRESERVE

For each species, codes for the communities in which it occurs are listed, followed by an abundance code (sometimes with supplemental habitat or abundance information), and collection number(s) of J. R. Abbott, unless otherwise noted. Voucher specimens are housed in FLAS, with a partial duplicate set at SEL. Species that have "*Hall NV*" in place of the collection number were reported by D. Hall during the 1980s. The communities in which these species are most likely to be expected are listed. Levy County records, based on Wunderlin et al. (1997), are indicated by the word "new" after the collection number(s). An asterisk (*) denotes non-native species.

The communities are: tidal marsh (TM), coastal hydric hammock (CH), basin swamp (SW), mesic to shrubby flatwood (FL), freshwater ponds and wet depressions (FP), and ruderal areas (RU). Abundance categories are: Rare (R), 1–4 occurrences; Infrequent (I), 5–9 occurences; Occasional (O), 10–24 occurrences; Frequent (F), ≥ 25 occurrences; and Abundant (A) for continuous occurrence. Abundance values reflect subjective estimates of species' frequencies.

See text for detailed information on this list.

LYCOPSIDA

SELAGINELLACEAE

Selaginella apoda (L.) Fern. – SW R, on raised hummock; *9981*

FILICOPSIDA

OPHIOGLOSSACEAE

Botrychium biternatum (Sav.) Underw. – TM; *Hall NV*

OSMUNDACEAE

Osmunda cinnamomea L. – SW R; *10400*

POLYPODIACEAE *sensu lato* (see Pryer et al. 1995)

Acrostichum danaefolium Langsd. & Fisch. – CH I, SW & FP F; *9684*
Asplenium platyneuron (L.) Britt. et al. – CH I; *9935*
Dryopteris ludoviciana (Kunze) Small – SW R; *10929*

Phlebodium aureum (L.) J. Sm. – CH & SW O, epiphytic on *Sabal palmetto*; *9526, 9662*

Pleopeltis polypodioides (L.) E. G. Andrews & Windham var. *michauxiana* (Weath.) E. G. Andrews & Windham – CH, SW & FL F, usually epiphytic; *11095* [= *Polypodium polypodioides* (L.) Watt; Andrews and Windham 1993; Windham 1993]

Pteridium aquilinum (L.) Kuhn – FL I; *9107*; new

**Pteris vittata* L. – RU R, on limestone outcrops; *9707*

Thelypteris hispidula (Decne.) C. F. Reed – CH; *Hall NV*

T. kunthii (Desv.) C. V. Morton – CH & SW I, locally A; *8955, 9153, 9927, 10179, 10921*

T. palustris Schott – SW R; *9129*

Vittaria lineata (L.) Sm. – CH & SW R, epiphytic; *9660*

Woodwardia virginica (L.) Sm. – SW; *Hall NV*

SCHIZAEACEAE

**Lygodium japonicum* (Thunb.) Sw. – RU R, near old homesite; *9155*; new

CYCADOPSIDA

ZAMIACEAE

Zamia floridana A. DC. – CH F; FL I; *8372* [but see Eckenwalder (1980), Landry (1993), Stevenson (1991), and Ward (1979) for different interpretations of the correct name]

CONIFEROPSIDA

CUPRESSACEAE (incl. TAXODIACEAE; Eckenwalder 1976; Hart 1987; Hart and Price 1990)

Juniperus virginiana L. var. *silicicola* (Small) Bailey – CH A; SW I; FL O; *8162* (Adams 1986)

Taxodium distichum (L.) Rich. – SW O; *9787*

PINACEAE

Pinus elliottii Englem. – FL R; *11131*

P. taeda L. – CH & FL F, locally A; *9181, 10018*

ANGIOSPERMAE

ACANTHACEAE

Dicliptera brachiata (Pursh) Spreng. – CH R; *9440*

Dyschoriste humistrata (Michx.) Kuntze – CH I; *10161, 10349*

D. oblongifolia (Michx.) Kuntze – CH R; *10560*

Elytraria caroliniensis (J. F. Gmel.) Pers. – CH O; *9168*

Ruellia caroliniensis (J. F. Gmel.) Steud. – CH F; SW R; *9439, 10160*

ACERACEAE (see SAPINDACEAE)

ADOXACEAE (incl. part of CAPRIFOLIACEAE; Judd et al. 1994)

Sambucus canadensis L. – FP R; *10163*
Viburnum dentatum L. – CH R; *9216, 10162*
V. obovatum Walt. – CH F, locally A; FL I; *9180, 9438, 9449, 9936, 10401*

AGAVACEAE

**Yucca aloifolia* L. – CH O, especially on or near coastal islands; *8411* (status as native or introduced is problematic)

AIZOACEAE (incl. TETRAGONIACEAE)

Sesuvium portulacastrum (L.) L. – TM O; *9130*
**Tetragonia tetragonioides* (Pall.) Kuntze – TM R; *10546*; new

ALISMATACEAE

Echinodorus berteroi (Spreng.) Fassett – FP R; *9481, 9555* [= *E. rostratus* (Nutt.) Engelm.]
Sagittaria graminea Michx. – FP R; *9453*
S. lancifolia L. – FP R; *9035*
S. subulata (L.) Buch. – FP R; *9452, 9482*; new

ALLIACEAE (Dahlgren et al. 1985; Fay and Chase 1996)

Nothoscordum bivalve (L.) Britt. – RU R, boundary trails; *8384, 10009*

AMARANTHACEAE

Amaranthus australis (A. Gray) J. D. Sauer – TM, SW & FP R *9188*
**A. spinosus* L. – RU R; *9233*; new
Atriplex pentandra (Jacq.) Standl. – TM R; *10539*; new
Blutaparon vermiculare (L.) Mears – TM R; *9849*
Chenopodium berlandieri Moq. – TM R; *10540*
Iresine diffusa Humb. & Bonpl. ex Willd. – CH R; *11096*
Salicornia bigelovii Torr. – TM F; *8929*
S. perennis Mill. – TM A; *8400* (= *S. virginica* L. of most authors; Clemants 1992)
Suaeda linearis (Ell.) Moq. – TM F; *9507*

AMARYLLIDACEAE (excl. ALLIACEAE and HYPOXIDACEAE)

Crinum americanum L. – SW & FP F; *10561*

ANACARDIACEAE

Rhus copallinum L. – CH & RU R; *9463*
**Schinus terebinthifolius* Raddi – TM R; *9933*
Toxicodendron radicans (L.) Kuntze – CH, SW & FL F; *8398, 9099*

ANNONACEAE

Asimina longifolia Kral – FL R; *9108* (= *A. angustifolia* Raf.; Kral 1997)

APIACEAE (= UMBELLIFERAE; incl. ARALIACEAE; Judd et al. 1994; Thorne 1983)

**Apium leptophyllum* (Pers.) F. Muell. – RU R; *9961*; new
Aralia spinosa L. – CH R; *10393*
Centella asiatica (L.) Urban – TM R; CH, BS, FL, FP & RU F, open wet areas; *9022*
Cicuta maculata L. – SW R; *10931*
Eryngium baldwini Spreng. – RU R; *9143*
Hydrocotyle umbellata L. – FP I; *9248*
H. verticillata Thunb. – TM R; CH, BS, FL, FP & RU F, open wet areas; *8951, 9247*
Oxypolis filiformis (Walt.) Britt. var. *filiformis* – RU R; *10983*
Ptilimnium capillaceum (Michx.) Raf. – FP I; *9176, 10363*
Sanicula canadensis L. – CH I; *9135*
Trepocarpus aethusae Nutt. ex DC. – CH I; *8907, 8954, 10395*

APOCYNACEAE (incl. ASCLEPIADACEAE; Endress et al. 1996; Judd et al. 1994)

Amsonia tabernaemontana Walt. – CH & FP R; *10190* (= *A. rigida* Shuttlew.)
Asclepias lanceolata Walt. – FP R; *9020*
A. perennis Walt. – CH & FP O; *8903, 9208*
Cynanchum angustifolium Pers. – TM & FL I; *8934, 10733*
C. scoparium Nutt. – TM R; CH F; FL I; *9520*
Matelea gonocarpos (Walt.) Shinners – CH O; *9184, 10189, 10481*

AQUIFOLIACEAE

Ilex cassine L. – SW R; *9093, 9655*
I. glabra (L.) A. Gray – FL I; *9697, 10737*
I. vomitoria Ait. – CH A; FL O; *9433*

ARACEAE (incl. LEMNACEAE, e.g., French et al. 1995; Mayo et al. 1995)

Lemna obscura (Austin) Daubs – FP R; *9554, 10098*
Peltandra virginica (L.) Schott & Endl. – SW R; *10925*; new

ARALIACEAE (see APIACEAE)

ARECACEAE (= PALMAE)

Rhapidophyllum hystrix (Pursh) H. Wendl. & Drude ex Drude – SW R, locally A; *9924*
Sabal minor (Jacq.) Pers. – CH I; *8900, 9411*
S. palmetto (Walt.) Lodd. ex Schultes & Schultes f. – TM, CH, SW, FL & FP A; *10538*
Serenoa repens (W. Bartr.) Small – CH R; FL O; *9613*

ASCLEPIADACEAE (see APOCYNACEAE)

ASTERACEAE (= COMPOSITAE)

Acmella oppositifolia (Lam.) R. K. Jansen var. *repens* (Walt.) R. K. Jansen – FP I; *9486* [= *Spilanthes americana* (Mutis ex L.f.) Hieron.; Jansen 1985]
Ageratina jucunda (Greene) Clewell & Wooten – CH R; *9651* (= *Eupatorium jucundum* Greene)
Ambrosia artemisiifolia L. – RU R; *9563*
Aster carolinianus Walt. – CH R; *9856*
A. dumosus L. – CH & RU R; *11133*
A. subulatus Michx. – TM & CH O; *9533, 10987*
A. tenuifolius L. – TM F; *9597, 9811*
A. tortifolius Michx. – FL R; *10992*
Baccharis angustifolia Michx. – TM F; *8166, 11123*
B. glomeruliflora Pers. – TM O; *8165*
B. halimifolia L. – TM, CH, SW, FL & FP F, often locally A; *11085, 11086*
Berlandiera subacaule (Nutt.) Nutt. – FL R; *9990, 10563*
Bidens alba (L.) DC. var. *radiata* (Sch. Bip.) R. E. Ballard ex Melchert – CH R; RU O; *9077*
B. bipinnata L. – CH & RU I; *9534, 10327*
B. mitis (Michx.) Sherff – FP R; *11093*
Boltonia diffusa Ell. – RU R; *9457*
Borrichia frutescens (L.) DC. – TM F, often locally A; *8909*
Carphephorus odoratissimus (J. F. Gmel.) Hebert – FL I; *9688, 10995*
Cirsium horridulum Michx. – RU R; *8388*
C. nuttallii DC. – CH & RU I; *8933*
Conoclinium coelestinum (L.) DC. – CH I; RU O; *9167, 9415* (= *Eupatorium coelestinum* L.)
**Conyza bonariensis* (L.) Cronq. – RU R; *10738*; new
C. canadensis (L.) Cronq. var. *pusilla* (Nutt.) Cronq. – RU O; *9244*
Coreopsis leavenworthii Torr. & A. Gray – FL O; *9019, 10567, 10996*
Eclipta prostrata (L.) L. – FP R; *9605* [= *E. alba* (L.) Hassk.]
Elephantopus carolinianus Raeusch. – CH I; *10922*
E. elatus Bertol. – CH & FL F; *9474, 11041*
E. nudatus A. Gray – CH & FL; *Hall NV*
Erechtites hieracifolia (L.) Raf. ex DC. – RU R; *9151, 9236*
Erigeron quercifolius Lam. – RU O; *8389, 9968, 10348*
E. vernus (L.) Torr. & A. Gray – RU R; *10998*
Eupatorium album L. – FL I; *9695, 11038*
E. capillifolium (Lam.) Small – TM, FP & RU R; *9639*
E. mikanioides Chapman – FL & RU I; *10402*; new
E. mohrii Greene – FL R; *11003*
E. perfoliatum L. – TM & RU R; *9590*
E. rotundifolium L. – FL & RU O; *10578*
E. serotinum Michx. – FL & RU O; *9637*
Euthamia caroliniana (L.) Greene ex Porter & Britt. – FL R; *11118* [= *E. tenuifolia* (Pursh) Nutt.]
Flaveria linearis Lag. – TM & RU F; CH I; *9634, 10188, 11101*

Fleischmannia incarnata (Walt.) R. M. King & H. Rob. – CH R; *9644, 11134* (= *Eupatorium incarnatum* Walt.)
Gamochaeta pensylvanica (Willd.) Cabrera – RU R; *9950* (= *Gnaphalium pensylvanicum* Willd.; Nesom 1990)
Helianthus angustifolius L. – FL R; *11039*
H. debilis Nutt. – TM R; *11089*
H. radula (Pursh) Torr. & Gray – FL R; *11037*
Heterotheca subaxillaris (Lam.) Britt. & Rusby – FL & RU O; *9623*
Iva frutescens L. – TM A; FP I; *9190, 10981*
I. microcephala Nutt. – RU R; *11005, 11087*
Lactuca canadensis L. – CH; *Hall NV*
L. floridana (L.) Gaertn. – CH R; *9665*; new
Liatris gracilis Pursh – FL & RU R; *9627*
L. graminifolia (Walt.) Willd. – FL & RU I; *9567, 10993*
L. tenuifolia Nutt. – FL & RU R; *9675*
Melanthera nivea (L.) Small – CH & RU O; *9548*
Mikania cordifolia (L. f.) Willd. – throughout O; *9587*
M. scandens (L.) Willd. – throughout F, locally A; *9448*
Pluchea longifolia Nash – SW & FP O; *9592, 10985*
P. odorata (L.) Cass. – SW & FP O; *9468, 10396*
P. rosea R. K. Godfrey – FP O; *9115*
Polymnia uvedalia (L.) L. – CH R; *9450*
Pterocaulon pycnostachyum (Michx.) Ell. – FL R; *8918*
Pyrrhopappus carolinianus (Walt.) DC. – RU R; *9969*
Rayjacksonia phyllocephala (DC.) R. L. Hartman & M. A. Lane – TM & CH O, island hammocks; *9566* (= *Haplopappus phyllocephalus* DC.; Lane and Hartman 1996)
Rudbeckia hirta L. – RU R; *8964, 9546*
R. laciniata L. – RU R; *9591*
R. triloba L. var. *pinnatiloba* Torr. & A. Gray – CH R, in open wet area; *8174*
Senecio glabellus Poir. – FP I; *8383*
Silphium astericus L. – FL & RU I; *8941*
Solidago fistulosa Mill. – CH I; *9678*
S. odora Ait. var. *chapmanii* (Torr. & A. Gray) Cronq. – FL & RU O; *11006*
S. rugosa Mill. var. *aspera* (Ait.) Cronq. – RU R; *9477, 11083*
S. sempervirens L. – TM & CH F; *9664*
S. stricta Ait. – TM & CH F; SW I; *9798*
S. tortifolia Ell. – RU O; *11040*
**Sonchus asper* (L.) Hill – RU R; *9951*; new
**Sphagneticola trilobata* (L.) Pruski – RU R; *9672*; new [= *Wedelia trilobata* (L.) Hitchc.; Pruski 1996]
Verbesina virginica L. – CH & RU I; *9593*
**Vernonia cinerea* (L.) Less. – RU; *Hall NV*
V. gigantea (Walt.) Trel. – CH & RU F; *9222, 9456, 9515*
Xanthium strumarium L. – RU R; *9594*; new
**Youngia japonica* (L.) DC. – RU I; *8364*

AVICENNIACEAE

Avicennia germinans (L.) L. – TM I; *9197*

BATACEAE

Batis maritima L. – TM F, locally A; *9810*

BETULACEAE

Carpinus caroliniana Walt. – CH F; *8960*
Ostrya virginiana (Mill.) K. Koch – CH R; *9423*

BIGNONIACEAE

Bignonia capreolata L. – CH O; *8478*
Campsis radicans (L.) Seem. ex Bureau – CH F; *11094*

BORAGINACEAE

Heliotropium curassavicum L. – TM R; *9205*
Lithospermum tuberosum Rugel ex DC. – CH R; *8390*; new

BRASSICACEAE (= CRUCIFERAE)

Cakile lanceolata (Willd.) O. E. Schulz – TM R; *10166, 10542*
Cardamine bulbosa (Schreb. ex Muhl.) Britt. et al. – SW R; *9967*
C. pensylvanica Muhl. ex Willd. – FP F; RU I; *9938, 9983*
**Coronopus didymus* (L.) Sm. – RU R; *9957*; new
Descurainia pinnata (Walt.) Britt. – RU R; *9948*
Lepidium virginicum L. – RU R; *9940*
**Raphanus raphanistrum* L. – RU R; *9978*

BROMELIACEAE

Tillandsia bartramii Ell. – CH O; SW F, epiphytic; *9444, 9521*
T. recurvata (L.) L. – CH, SW, & FL F, epiphytic; *9522*
T. usneoides (L.) L. – TM, CH, SW & FL F, locally abundant, epiphytic; *9061*

CACTACEAE

Opuntia stricta (Haw.) Haw. – TM & CH F; *8175*

CAMPANULACEAE

Campanula floridana S. Watson – RU R; *10157*
Lobelia cardinalis L. – SW R; *9580*
L. feayana Gray – RU R; *10023*
L. glandulosa Walt. – FP & RU R; *9790*
Triodanis perfoliata (L.) Nieuwl. – RU R; *9962* (Bradley 1975)

CANNACEAE

Canna flaccida Salisb. – SW & RU R; *8959*

CAPRIFOLIACEAE (see also ADOXACEAE)

Lonicera sempervirens L. – CH I; *8359*
Symphoricarpos orbiculatus Moench – CH R; *10200*

CARYOPHYLLACEAE

Arenaria lanuginosa (Michx.) Rohrb. – CH R, near wet depression and clearing; *10328*; new
**A. serpyllifolia* L. – RU R; *10007*
**Cerastium glomeratum* Thuill. – RU R; *9943, 9979*; new
**Stellaria media* (L.) Vill. – RU R; *9942*; new

CELASTRACEAE

Euonymus americanus L. – CH R; *9643*
Maytenus phyllanthoides Benth. – CH R, island hammocks; *8379, 9930*

CELTIDACEAE (Grudzinskaja 1967; Judd et al. 1994)

Celtis laevigata Willd. – CH O; *10482*

CERATOPHYLLACEAE

Ceratophyllum echinatum A. Gray – FP R; *11097*

CHENOPODIACEAE (see AMARANTHACEAE)

CISTACEAE

Lechea mucronata Raf. – FL R; *9138*

CLUSIACEAE (= GUTTIFERAE; incl. HYPERICACEAE)

Hypericum cistifolium Lam. – FL R; *9134*
H. hypericoides (L.) Crantz – CH, FL & RU I; *9466, 9581, 9702*
H. tetrapetalum Lam. – FL R; *9142*

COMMELINACEAE

Commelina diffusa Burm. f. – RU I; *9598*; new
C. erecta L. – FL R; *10562*
**Murdannia nudiflora* (L.) Brenan – RU I; *9253*; new

CONVOLVULACEAE

Dichondra carolinensis Michx. – CH, FL & RU, F; *8397, 9973*
Evolvulus sericeus Sw. – CH & FL; *Hall NV*
Ipomoea cordatotriloba Dennst. – RU R; *9465* (= *I. trichocarpa* Ell.)
**I. hederacea* Jacq. – RU; *Hall NV*
I. lacunosa L. – RU R; *9586*
**I. macrorhiza* Michx. – RU R; *9793*
I. pandurata (L.) G. Mey. – CH & RU I; *10340, 10920*

I. pes-caprae (L.) R. Br. – TM R; *9851*
I. sagittata Poir. – TM F; CH & RU O; *9080*

CORNACEAE (incl. NYSSACEAE; e.g., Eyde 1988)

Cornus asperifolia Michx. – CH R; SW I; *9219, 10151, 10394*
C. foemina Mill. – CH R; SW I; *10150*
Nyssa biflora Walt. – CH R; SW I; *10484* (Burkhalter 1992)

CUCURBITACEAE

Melothria pendula L. – CH, FL & RU I; *9220, 9636*

CYPERACEAE

Bulbostylis stenophylla (Ell.) C. B. Clarke – FL R; *9680*
Carex blanda Dewey – CH R; *8380*; new
C. chapmannii Steud. – CH & RU I; *10014, 10027*
C. cherokeensis Schwein. – CH & RU I; *8897, 10199*
C. fissa Mack. – FP R; *10145*
C. godfreyi Naczi – CH & RU I; *10031* (Naczi 1993)
C. hyalinolepis Steud. – FP & RU I; *9991, 10185*
C. lupuliformis Sartwell ex Dewey – SW R; *8949*
C. vexans F. J. Herm. – SW R; *10148*
Carex sp. nov. (sect. *Granulares*) – CH R; *10029, 10146* (R. Naczi, pers. comm.)
Carex sp. nov. (sect. *Griseae*) – CH R; *8382* (R. Naczi, pers. comm.)
Cladium jamaicense Crantz – TM & FP F, locally A; *9032*
Cyperus compressus L. – RU R; *9235*
C. croceus Vahl – RU R; *9542* (= *C. globulosus* Aubl.)
C. distinctus Steud. – FP & RU O; *9530*
**C. esculentus* L. – TM R; *9858*
C. flavescens L. – FP & RU R; *9172, 9239, 9956*
C. haspan L. – FP I; *9455*
C. ligularis L. – FP R, brackish water; *11125*
C. odoratus L. – SW & FP F; *9569*
C. planifolius Rich. – TM & FP; *Hall NV*
C. polystachyos Rottb. – FP & RU F; *8921, 9123, 9154, 9536, 10990*
C. retrorsus Chapman – FL & RU O; *9141, 9211*
**C. rotundus* L. – RU R; *9960*; new
C. strigosus L. – RU R; *9230*
C. surinamensis Rottb. – RU R; *9224*
C. tetragonus Ell. – CH F; *9510, 9531*
C. virens Michx. – FP R; *10491*
Eleocharis albida Torr. – TM R; FP F; *8387, 9104, 9122, 9418, 9562, 10172*
E. atropurpurea (Retz.) J. Presl & C. Presl – FP R; *9472*
E. baldwinii (Torr.) Chapm. – FP; *Hall NV*
E. cellulosa Torr. – TM R; *9596*
E. geniculata (L.) Roemer & Schultes – FP F; *9062, 9105*
E. montevidensis Kunth – FP R; *10182*
Fimbristylis autumnalis (L.) Roemer & Schultes – RU R; *9701*

F. caroliniana (Lam.) Fern. – CH R, near salt marsh; *11046*
F. dichotoma (L.) Vahl – FL & RU O; *9136, 9250*
F. spadicea (L.) Vahl – TM & CH F; *8896, 9203, 9523, 9620, 10339, 10551* [= *F. castanea* (Michx.) Vahl]
Fuirena breviseta (Coville) Coville – FP R; *9789*
**Kyllinga brevifolia* Rottb. – RU R; *9240* [= *Cyperus brevifolius* (Rottb.) Endl. ex Hassk.]
K. pumila Michx. – FP & RU I; *9261, 9479* [= *Cyperus tenuifolius* (Steud.) Dandy]
Rhynchospora caduca Ell. – FL & RU O; *9027, 10362, 10573*; new
R. colorata (L.) H. Pfeiffer – CH & FP O; RU F; *8966, 9215, 9667,10353* [= *Dichromena colorata* (L.) A. S. Hitchc.]
R. corniculata (Lam.) A. Gray – SW & FP I; *9458*
R. fascicularis (Michx.) Vahl – FL & RU F, locally A; *8945, 9101, 9126, 9693, 10740, 11014*
R. megalocarpa A. Gray – FL; *Hall NV*
R. microcarpa Baldw. ex A. Gray – FL & RU O; *9028, 10335*
R. miliacea (Lam.) A. Gray – CH & SW R; *9125, 10487*
R. mixta Britt. ex Small – SW & FP; *Hall NV*
Scirpus californicus (C. A. Mey.) Steud. – FP R; *9204*
S. lineatus Michx. – SW R; *10149*
S. robustus Pursh – TM R; *9191*; new
S. tabernaemontani C. C. Gmel. – FP I; *10338* (= *S. validus* Vahl)
Scleria oligantha Michx. – CH & RU F; *8381, 9024*
S. triglomerata Michx. – CH & RU F; *8939*
S. verticillata Muhl. ex Willd. – FL I; *9686, 9791*

DIOSCOREACEAE

Dioscorea floridana Bartlett – CH R; *9441, 9642*

EBENACEAE

Diospyros virginiana L. – CH & FL F; *9045*

ERICACEAE

Bejaria racemosa Vent. – FL R; *9117*
Gaylussacia nana (Gray) Small – FL R; *9698*
Lyonia fruticosa (Michx.) G. S. Torr. – FL R; *8935, 9112*
L. lucida (Lam.) K. Koch – FL R; *8938*
Vaccinium arboreum Marsh. – CH & FL I; *8944*
V. darrowii Camp – FL; *Hall NV*
V. myrsinites Lam. – FL R; *9139*
V. stamineum L. – FL R; *11122*

EUPHORBIACEAE

Acalypha gracilens A. Gray – CH & RU R; *10984*
Chamaesyce blodgettii (Engelm. ex Hitchc.) Small – CH, FL & RU F, often on exposed limestone; *9041, 9199*

C. hyssopifolia (L.) Small – RU R; *10543*
C. maculata (L.) Small – RU R; *10544*
C. mesembrianthemifolia (Jacq.) Dugand – TM R; *10545*; new
Euphorbia commutata Engelm. ex A. Gray – CH R; *9937*
Phyllanthus caroliniensis Walt. – CH; *Hall NV*
P. liebmannianus Muell. Arg. ssp. *platylepis* (Small) G. L. Webster – CH I; *10176*
**P. urinaria* L. – RU I; *9471*; new
Poinsettia cyathophora (Murr.) Bartl. – RU; *Hall NV*

FABACEAE (= LEGUMINOSAE)

**Albizia julibrissin* Durazz. – RU R; *9786*
Amorpha fruticosa L. – CH, FL & FP O; *8919, 9201, 10154*
Centrosema virginianum (L.) Benth. – FL R; *8922*
Cercis canadensis L. – CH R; *9992*
Chamaechrista fasciculata (Michx.) Greene – RU O; *9081, 10556*
C. nictitans (L.) Moench var. *aspera* (Muhl. ex Ell.) Irwin & Barneby – RU R; *9679*
Crotalaria rotundifolia J. F. Gmel. – RU O; *10729*
**C. spectabilis* Roth – RU R; *11056*; new
Dalea carnea (Michx.) Poir. – FL R; *9710*
Desmanthus virgatus (L.) Willd. – FL & RU R; *9089*
Desmodium glabellum (Michx.) DC. – RU R; *10994*
D. incanum DC. – RU I; *9076, 9540*
D. marilandicum (L.) DC. – RU; *Hall NV*
D. paniculatum (L.) DC. – RU I; *9511*
**D. tortuosum* (Sw.) DC. – RU R; *9611*; new
**D. triflorum* (L.) DC. – RU R; *9595*
Erythrina herbacea L. – CH O; *8902*
Galactia elliottii Nutt. – FL R; *10387*
G. volubilis (L.) Britt. – CH & FL O; *8952*
Gleditsia aquatica Marsh. – SW R; *8931*
G. triacanthos L. – CH I; SW & FP R; *8480, 9060*; new
**Kummerowia striata* (Thunb.) Schindl. – RU R; *9447*
Lespedeza angustifolia (Pursh) Ell. – FL; *Hall NV*
L. hirta (L.) Hornem. – FL; *Hall NV*
**Medicago lupulina* L. – RU R; *9140*
**Melilotus albus* Medik. – RU R; *9097, 9952*
**M. indicus* (L.) All. – RU R; *10549*
Neptunia pubescens Benth. – FL & RU I; *9086*
Phaseolus smilacifolius Pollard – CH R; *8472, 9557, 9670, 11136* [This taxon was considered to be a hybrid by Isely (1990), apparently based on one sterile specimen. Field observation by the first author and 100% germination in a greenhouse of 221 seeds from 7 individual plants, with identical progeny all like the parents, strongly support the recognition of this entity as a distinct species.]
Rhynchosia michauxii Vail – RU R, sandy roadside through salt marsh; *11051*
R. minima (L.) DC. – FL & RU I; *9541*

Senna marilandica (L.) Link – RU R; *10928*
**S. obtusifolia* (L.) H. S. Irwin & Barneby – RU R; *9214, 9427*
Sesbania herbacea (Mill.) McVaugh – RU R; *9549* (= *S. macrocarpa* Muhl. ex Raf.)
S. vesicaria (Jacq.) Ell. – FP I; RU O; *9589*
**Trifolium campestre* Schreb. – RU R; *9977*
Vicia acutifolia Ell. – CH & RU O; *8406, 8492*
V. floridana S. Wats. – CH & RU O; *8407, 8467*
**V. sativa* L. – RU R; *9975*

FAGACEAE

Quercus chapmanii Sarg. – FL; *Hall NV*
Q. geminata Small – FL R; *9147*
Q. laurifolia Michx. – CH F; SW & FL O; *9451*
Q. michauxii Nutt. – CH R; *9217*
Q. myrtifolia Willd. – FL R; *11127*
Q. nigra L. – CH R; *9218, 9431*
Q. pumila Walt. – FL; *Hall NV*
Q. shumardii Buckl. – CH I; *9051*
Q. virginiana Mill. – CH F, locally A; FL O; *9114, 9422*

FUMARIACEAE (see PAPAVERACEAE)

GENTIANACEAE

Eustoma exaltatum (L.) Salisb. ex G. Don – TM, FP & RU O; *9509*
Sabatia calycina (Lam.) A. Heller – FP F; RU O; *8913, 10030*
S. stellaris Pursh – FL & FP I; RU O; *8910, 9021*

GERANIACEAE

Geranium carolinianum L. – RU R; *9945*

HALORAGACEAE

Myriophyllum pinnatum (Walt.) Britt. et al. – FP O; *9539, 9996*; new
Proserpinaca palustris L. – FP F; *8953*
P. pectinata Lam. – FP; *Hall NV*

HAMAMELIDACEAE

Liquidambar styraciflua L. – CH O; SW F; FL I; *9152*

HIPPOCASTANACEAE (see SAPINDACEAE)

HYDRANGEACEAE (distinct from SAXIFRAGACEAE; e.g., Morgan and Soltis 1993)

Decumaria barbara L. – SW R; *11084*

HYDROCHARITACEAE

**Hydrilla verticillata* (L. f.) Royle – reportedly in Kelly Creek; *Hall NV*

HYPERICACEAE (see CLUSIACEAE)

HYPOXIDACEAE

Hypoxis curtissii Rose – CH & RU O; *8479, 9429* (= *H. leptocarpa* Engelm.; Herndon 1992a, 1992b)

IRIDACEAE

Iris hexagona Walt. – FP F; *8386*
Sisyrinchium atlanticum E. P. Bickn. – CH & RU O; *8392, 10025* (This species is not synonymous with *S. angustifolium,* which does not occur in Florida; Dan Ward, pers. comm.)
**S. rosulatum* E. P. Bickn. – RU R; *10331, 10332* (incl. *S. exile* E. P. Bickn.)

JUGLANDACEAE

Carya aquatica (F. Michx.) Nutt. – SW R; *9659*
C. glabra (Mill.) Sweet – CH O; SW & FL I; *9156*

JUNCACEAE

Juncus coriaceus Mack. – CH R; RU I; *10195*
J. dichotomus Ell. – CH R, near wet depression; *9238*
J. marginatus Rostk. – FP & RU O; *8936, 8963*
J. megacephalus M. A. Curtis – FP R; *10367*
J. polycephalus Michx. – FP R; *9171*
J. roemerianus Scheele – TM A; FP R; *10017*
J. scirpoides Lam. – FP R; *10741*
J. tenuis Willd. – RU R; *10194*

JUNCAGINACEAE

Triglochin striata Ruiz & Pavon – TM F; *9417*

LAMIACEAE (= LABIATAE; incl. part of VERBENACEAE; Cantino 1992; Thorne 1992)

Callicarpa americana L. – CH & FL F; *9048*
Hyptis alata (Raf.) Shinners – RU I; *9225*
**H. mutabilis* (Rich.) Briq. – RU R; *9207, 9583*
**Lamium amplexicaule* L. – RU R; *9941*; new
Monarda punctata L. – RU R; *9621*
Salvia coccinea Buc'hoz ex Etl. – CH; *Hall NV*
S. lyrata L. – CH & RU R; *10021*
Scutellaria arenicola Small – FL R; *9691*
Teucrium canadense L. – CH O; *9185*
Trichostema dichotomum L. – FL & RU I; *9464, 9600*

LAURACEAE

Persea borbonia (L.) Spreng. – CH R, island hammocks; *9195*
P. palustris (Raf.) Sarg. – CH, SW & FL F; *9110, 10735*

LEITNERIACEAE (see SIMAROUBACEAE)

LEMNACEAE (see ARACEAE)

LENTIBULARIACEAE

Utricularia foliosa L. – FP R; *9800*; new

LINACEAE

Linum medium (Planch.) Britt. – FL & RU R; *10138, 10352*

LOGANIACEAE

Gelsemium sempervirens (L.) W. T. Ait. – CH & FL I; *9030, 9972*
Mitreola petiolata (J. F. Gmel.) Torr. & A. Gray – FP F; *9174, 9229*
M. sessilifolia (J. F. Gmel.) G. Don – FP; *Hall NV*
Polypremum procumbens L. – RU R; *8943, 9246* (Familial placement is still in doubt; see Jensen 1992.)
Spigelia loganioides (Torr. & A. Gray ex Endl. & Fenzl) A. DC. – CH R; *Judd 2660*

LYTHRACEAE

Ammania latifolia L. – FP F; *8915*; new
**Cuphea carthagenensis* (Jacq.) J. F. Macbr. – RU R; *9245*
Decodon verticillatus (L.) Ell. – SW; *Hall NV*
Lythrum alatum Pursh var. *lanceolatum* (Ell.) Torr. & A. Gray ex Rothr. – FP & RU I; *10574*
L. lineare L. – TM I; *9421*; new

MAGNOLIACEAE

Magnolia grandiflora L. – CH O; SW F; FL R; *9145*
M. virginiana L. – SW I; *9128*

MALVACEAE (incl. BOMBACACEAE, STERCULIACEAE, TILIACEAE; Judd and Manchester 1997)

Abutilon hulseanum (Torr. & A. Gray) Torr. ex A. Gray – RU R; *10397*
Hibiscus coccineus Walt. – FP O; *9795*
H. grandiflorus Michx. – FP I; *9535*; new
Kosteletzkya virginica (L.) C. Presl ex A. Gray – FP I; *10407*
**Melochia corchorifolia* L. – RU; *Hall NV*
Modiola caroliniana (L.) G. Don – RU R; *10403*
**Pavonia hastata* Cav. – RU R; *10398*
Sida rhombifolia L. – RU O; *9192, 10986*
**S. spinosa* L. – RU R; *11057*; new
Tilia americana L. var. *caroliniana* (Mill.) Castig. – CH I; *9057, 10020*

MARANTACEAE

Thalia geniculata L. – FP R; *11088*; new

MENISPERMACEAE

Cocculus carolinus (L.) DC. – RU R, boundary trail; *9043*

MORACEAE

Morus rubra L. – CH I; *8463*

MYRICACEAE

Myrica cerifera L. var. *cerifera* – CH, SW & FL F, locally A; *10026*
M. cerifera L. var. *pumila* Michx. – FL R; *10732* (This entity is not usually given taxonomic recognition, but we point it out here because we think it may be distinct and it should be studied in more detail. This entity is a fire-adapted dwarf shrub restricted to well-drained sandy soils. The habitat may represent a natural ecological barrier leading to reproductive isolation from var. *cerifera*. The two taxa may also be isolated, in part, by different blooming periods.)

MYRSINACEAE

Rapanea punctata (Lam.) Lundell – CH I; *8366, 9506* (= *Myrsine floridana* A. DC.)

MYRTACEAE

Eugenia axillaris (Sw.) Willd. – CH R, island hammocks; *9200*

NAJADACEAE

Najas marina L. – TM R, submerged aquatic; *9803*; new

NYCTAGINACEAE

Boerhavia diffusa L. – RU R; *10541*

NYMPHAEACEAE

Nymphaea elegans Hook. – FP R; *9480*; new
N. odorata Sol. – FP R; *9454*

NYSSACEAE (see CORNACEAE)

OLACACEAE

Ximenia americana L. – CH; *Hall NV*

OLEACEAE

Forestiera ligustrina (Michx.) Poir. – CH O; *9505, 9529, 9796*
F. segregata (Jacq.) Krug & Urban – TM O; CH F; *8371, 8925, 10547*
Fraxinus caroliniana Mill. – SW I; *10489*
F. pennsylvanica Marsh. – CH & SW O; *9054, 10184*

Osmanthus americana (L.) Benth. & Hook. f. ex A. Gray – SW R; *9674*

ONAGRACEAE

Gaura angustifolia Michx. – RU I; *9096*
Ludwigia maritima R. M. Harper – FL I; *10731*
L. microcarpa Michx. – FP F; *9178, 10336*
L. repens J. R. Forst. – FP O; *8948*
Oenothera laciniata Hill – RU R; *10008*

ORCHIDACEAE

Epidendrum conopseum R. Br. – CH & SW F; *8170*
Habenaria floribunda Lindl. – SW R; *9121* (= *H. odontopetala* Reichenb. f.)
Hexalectris spicata (Walt.) Barnh. – CH R; *9095*
Malaxis spicata Sw. – SW R; *10917*

OXALIDACEAE

Oxalis corniculata L. – RU R; *9963*
O. florida Salisb. ssp. *prostrata* (Haworth) Lourt. – RU I; *9243* [Perhaps this should be treated as *Oxalis dillenii* ssp. *filipes* as suggested by Eiten (1963), but we await a modern revision.]

PAPAVERACEAE (incl. FUMARIACEAE; Judd et al. 1994; Kadereit et al. 1994, 1995; Loconte et al.1995)

Corydalis micrantha (Engelm. ex A. Gray) A. Gray – RU R; *9949*; new

PASSIFLORACEAE

Passiflora lutea L. – CH; *Hall NV*
P. suberosa L. – CH I; *8461*

PHYTOLACCACEAE

Phytolacca americana L. var. *rigida* (Small) Caulkins & Wyatt – CH & RU I; *9603* (Caulkins and Wyatt 1990)

PLANTAGINACEAE

**Plantago major* L. – RU R; *8957*; new
P. virginica L. – RU R; *10143*

PLUMBAGINACEAE

Limonium carolinianum (Walt.) Britt. – TM F; *9419*

POACEAE (= GRAMINEAE)

Andropogon glomeratus (Walt.) Britt. et al. var. *glaucopsis* (Ell.) C. Mohr – FL R; *11119* (Campbell 1983)

A. glomeratus (Walt.) Britt. et al. var. *pumilus* (Vasey) Vasey ex L. H. Dewey – FL & RU F; *9625, 9654, 9797, 11060, 11121, 11124, 11128*
A. gyrans Ashe var. *stenophyllus* (Hackel) C. S. Campb. – FL & RU I; *9704*
A. longiberbis Hackel – FL; *Hall NV*
A. virginicus L. var. *virginicus* – FL & RU O; *9692, 9708* (Both old-field and smooth variants are present.)
Aristida beyrichiana Trin. & Rupr. – FL; *Hall NV*
A. patula Chapman ex Nash – FL & RU R; *10726, 11036* (Allred 1986)
A. purpurascens Poir. – FL R; *9614*; new
A. spiciformis Ell. – FL I; *9116*
Arundinaria gigantea (Walt.) Walt. ex Muhl. – RU R; *9965*; new
Axonopus fissifolius (Raddi) Kuhlm. – RU I; *9132, 9209, 9432, 9709* (= *A. affinis* Chase)
A. furcatus (Fluegge) Hitchc. – RU R; *9210*
**Bothriochloa pertusa* (L.) A. Camus – RU R; *9082, 9616* (These specimens are atypical, with non-pitted glumes.)
Cenchrus echinatus L. – RU R; *9256*
C. incertus M. A. Curtis – CH R; RU O; *9857, 11052*
C. myosuroides Kunth – CH R, open island hammock; *9518*; new
Chasmanthium laxum (L.) Yates – CH & RU F; *9653, 9711*
C. nitidum (Baldw.) Yates – CH & RU F; *8961, 9699*
C. sessiliflorum (Poir.) Yates – CH & RU F; *9669*
**Cynodon dactylon* (L.) Pers. – RU I; *10193*
Digitaria ciliaris (Retz.) Koel. – FL & RU F; *9622, 10580*
**D. violascens* Link – RU R; *11045*
Distichlis spicata (L.) Greene – TM A; *9426, 9508*
**Echinochloa colona* (L.) Link – FP & RU R; *9435, 10173*; new
**E. crusgalli* (L.) P. Beauv. – FP O; *8916, 9568*
E. walteri (Pursh) A. Heller – FP R; *9656*; new
**Eleusine indica* (L.) Gaertn. – RU I; *9226*
Elymus virginicus L. – CH I; *8912*
Eragrostis elliottii S. Wats. – FL & RU O; *9588, 11042, 11047*
E. hirsuta (Michx.) Nees – FL & RU R; *9618*
E. virginica (Zucc.) Steud. – RU R; *9683, 11013*
**Eremochloa ophiuroides* (Munro) Hack. – RU O; *9146, 9544*
Eriochloa michauxii (Poir.) Hitchc. – CH R, near wet depression; *9794*
Eustachys glauca Chapm. – RU F; *10366* [= *Chloris glauca* (Chapm.) Wood]
E. petraea (Sw.) Desv. – RU F; *9519* (= *Chloris petraea* Sw.)
Leersia hexandra Sw. – FP; *Hall NV*
L. virginica Willd. – FP & RU R; *9663*
Leptochloa fascicularis (Lam.) A. Gray – FP & RU R; *9635*
Melica mutica Walt. – CH O, RU R; *8399*
Monanthochloe littoralis Engelm. – TM; *Hall NV*
Muhlenbergia capillaris (Lam.) Trin. – RU R; *9855, 11061*
Oplismenus hirtellus (L.) Beauv. ssp. *setarius* (Lam.) Mez ex Ekman – CH F; *9652* (Scholz 1981)
Panicum aciculare Desv. ex Poir. – FL & RU I; *10358, 10569* (*Dichanthelium* is treated as a subgenus; Webster 1988; Zuloaga 1986.)

P. anceps Michx. – CH & RU F; *9460*
P. commutatum Schultes – CH F; *8401, 9119, 9929*
P. dichotomiflorum Michx. – RU R; *11009*; new
P. dichotomum L. – FL & RU F; *10488, 10933*
P. ensifolium Baldw. ex Ell. – RU R; *10357*
P. gymnocarpon Ell. – FP R; *11090*
P. laxiflorum Lam. – CH O; *8477, 9148*
P. portoricense Desv. ex Ham. – RU R; *11002*
**P. repens* L. – FP; *Hall NV*
P. rigidulum Bosc ex Nees – CH & RU F; *9437, 9538, 10932*
P. virgatum L. – CH & RU F; *9503, 9514, 9545, 10727, 11011*
Paspalum caespitosum Fluegge – RU; *Hall NV*
**P. dilatatum* Poir. – RU R; *9175*
P. floridanum Michx. – RU F; *9049, 9804, 10399*
P. langei (E. Fourn.) Nash – RU O; *9461*; new
**P. notatum* Fluegge – RU F; *10365, 10581*
P. repens Berg. – FP I; *9556, 10479* [= *P. fluitans* (Ell.) Kunth]
P. setaceum Michx. – RU O; *9501, 9649*; new
**P. urvillei* Steud. – RU O; *9050*; new
P. vaginatum Sw. – TM R; *11032*; new
**Poa annua* L. – RU R; *9954*; new
**Polypogon monspeliensis* (L.) Desf. – FP & RU R; *9173, 10175*
Saccharum giganteum (Walt.) Pers. – RU R, near salt marsh; *9624, 11049* [= *Erianthus giganteus* (Walt.) Muhl.]
Schizachyrium scoparium (Michx.) Nash – FL R; *11048*
**Secale cereale* L. – RU R; *10174*
Setaria macrosperma (Scribn. & Merr.) K. Schum. – FL & RU I; *9513*
S. parviflora (Poir.) Kerguelen – CH I; RU F; *9084, 9560* [= *S. geniculata* (Lam.) Beauv.]
Sorghastrum elliottii (C. Mohr) Nash – FL O; RU R; *9647, 9668, 9687, 11035*; new
Spartina alterniflora Loisel – TM F, locally A; *9196, 9685, 9854, 11031*
S. cf. *bakeri* Merr. – FL I; *10989*; sterile
S. patens (Ait.) Muhl. – TM F, locally A; *9202*
S. spartinae (Trin.) Merr. ex Hitchc. – TM O; *9517*; new
Sphenopholis obtusata (Michx.) Scribn. – CH & RU R; *10028*
**Sporobolus indicus* (L.) R. Br. – RU R; *9442*
S. virginicus (L.) Kunth – TM F, locally A; *9852, 10734*
Stenotaphrum secundatum (Walt.) Kuntze – CH, FL & RU A; *8899*
Tridens flavus (L.) Hitchc. – FL & RU I; *9551, 9638, 9703, 11044*
Tripsacum dactyloides (L.) L. – RU I; *9039*

POLYGALACEAE

Polygala boykinii Nutt. – RU R, near wet depression; *10155*
P. grandiflora Walt. – FL & RU O; *9018, 10564*
P. incarnata L. – FL & RU R; *8926*
P. nana (Michx.) DC. – FL R; *8942*

POLYGONACEAE

Polygonum hydropiperoides Michx. – FP O; *9232, 9478*
P. punctatum Ell. – FP O; *10936, 11001*
Rumex verticillatus L. – FP R; *10924*; new

PORTULACACEAE

**Portulaca amilis* Speg. – RU R; *9255*; new

POTAMOGETONACEAE

Potamogeton pectinatus L. – FP; *Hall NV*

PRIMULACEAE

Anagallis minima (L.) E. H. L. Krause – RU R, near salt marsh; *8396* (= *Centunculus minimus* L.)
Samolus ebracteatus Kunth – TM, CH & FP F; *8394, 10171*
S. valerandi L. ssp. *parviflorus* (Raf.) Hulten – TM I; CH, SW & FP F; *10170*

RANUNCULACEAE

Clematis catesbyana Pursh – CH R, near boundary trail; *9641*
C. crispa L. – CH R, near wet depressions; *9040, 9859*

RHAMNACEAE

Berchemia scandens (Hill) K. Koch – CH O; *9412*
Sageretia minutiflora (Michx.) C. Mohr – CH F; *8358, 8466*

ROSACEAE

Crataegus aestivalis (Walt.) Torr. & A. Gray – CH R; *9428*; new
Photinia pyrifolia (Lam.) K. R. Robertson & J. B. Phipps – FL R, edge of wet depression; *10004* [= *Aronia arbutifolia* (L.) Pers.]
Prunus americana Marsh. – CH R; *9966, 10326*
P. serotina Ehrh. – FL R; *9118*
P. umbellata Ell. – CH; *Hall NV*
Rosa palustris Marsh. – CH R, edge of wet depression; *10158*
Rubus argutus Link – CH R; *9971, 10142*
R. cuneifolius Pursh – CH R; *9103*
R. trivialis Michx. – CH O; *10005*

RUBIACEAE

Cephalanthus occidentalis L. – FP O; *9059*
Chiococca alba (L.) Hitchc. – CH R; *8173, 9504*
Diodia virginiana L. – FP O; RU I; *9249, 9462, 10329*
Galium hispidulum Michx. – CH O; *9088, 9502*
G. pilosum Ait. – CH R; *10571*
G. tinctorium L. – RU I; *10152*

**Hedyotis corymbosa* (L.) Lam. – RU R; *9254*; new
H. procumbens (J. F. Gmel.) Fosberg – FL; *Hall NV*
Mitchella repens L. – CH; *Hall NV*
**Mitracarpus hirtus* (L.) DC. – RU R; *10345*; new [Perhaps the name should be *M. villosus* (Sw.) Cham. & Schlecht.; Ward 1976.]
Psychotria nervosa Sw. – CH; *Hall NV*
**Richardia brasiliensis* Gomez – RU R; *9242*; new
Spermacoce assurgens Ruiz & Pavon – RU; *Hall NV*
**S. prostrata* Aubl. – CH & RU R; *9689* [= *Borreria ocimoides* (Burm. f.) DC.]

RUPPIACEAE

Ruppia maritima L. – TM F; FP I; *9801, 9989*

RUTACEAE

**Citrus aurantium* L. – CH R; *9169*; new
Ptelea trifoliata L. – CH R; *8360, 10198*
Zanthoxylum clava-herculis L. – CH I; *10197*
Z. fagara (L.) Sarg. – CH; *Hall NV*

SALICACEAE

Salix caroliniana Michx. – FP O; *9994, 10016*

SAPINDACEAE (incl. ACERACEAE and HIPPOCASTANACEAE; Judd et al. 1994)

Acer rubrum L. – CH I; SW O; *9037, 9926*
A. saccharum Marsh. ssp. *floridanum* (Chapman) Desmarais – CH F; SW I; *8481, 9065*
Aesculus pavia L. – CH R; *9213*
Sapindus saponaria L. – CH I; *8409, 9516* (incl. *S. marginatus* Willd.)

SAPOTACEAE

Sideroxylon celastrinum (Kunth) T. D. Penn. – CH R, island hammock; *10548* (= *Bumelia celastrina* H.B.K.; Pennington 1991)
S. lanuginosum Michx. – CH R; *8373, 9553* [= *Bumelia lanuginosa* (Michx.) Pers.]
S. reclinatum Michx. – CH; *Hall NV* (= *Bumelia reclinata* Vent.)

SAURURACEAE

Saururus cernuus L. – FP O; *8904*

SAXIFRAGACEAE (see HYDRANGEACEAE)

SCROPHULARIACEAE

Agalinis maritima (Raf.) Raf. – TM F; *8920, 9170, 9608, 10554*
A. tenuifolia (Vahl) Raf. – FL R; *9582*

Bacopa monnieri (L.) Pennell – TM, CH, FP & RU F; SW I; *9420, 10187*
Buchnera americana L. – FL R; *10566*
Conobea multifida (Michx.) Benth. – RU R; *10192*; new [= *Leucospora multifida* (Michx.) Nutt.]
Gratiola hispida (Benth. ex Lindl.) Pollard – FL R; *8940*
Linaria canadensis (L.) Chaz. – RU R; *9953*
**Lindernia crustacea* (L.) F. Muell. – RU R; *9251, 9599*; new
Mecardonia acuminata (Walt.) Small – FP R; *9258*
Penstemon multiflorus (Benth.) Chapman ex Small – FL R; *10575*
Scoparia dulcis L. – RU R; *9257, 11008*
Scrophularia marilandica L. – RU R, boundary trail near access gate; *10982*; new
**Veronica arvensis* L. – RU R; *9946*; new
V. peregrina L. – RU R; *9947*; new

SIMAROUBACEAE (incl. LEITNERIACEAE; Fernando et al. 1995)

Leitneria floridana Chapman – FP F; *8486, 9047, 9445, 9934*

SMILACACEAE

Smilax auriculata Walt. – CH F; SW & FL O; *9058, 9109*
S. bona-nox L. – CH A; SW & FL O; *8405, 9853*
S. glauca Walt. – FL R; *9700*; new
S. laurifolia L. – CH R; *10477*
S. pumila Walt. – FL R; *11120*
S. smallii Morong – CH R; *8402*
S. tamnoides L. – CH F; *9661*

SOLANACEAE

Lycium carolinianum Walt. – TM F, locally A; *8163, 9850*
Physalis walteri Nutt. – FL & RU O; *8375, 9092, 10169*
Solanum carolinense L. – RU R; *8962, 9234*
S. chenopodioides Lam. – RU R; *10550*

STERCULIACEAE (see MALVACEAE)

STYRACACEAE

Styrax americanus Lam. – CH R, edge of wet depression; *10024*

TILIACEAE (see MALVACEAE)

TURNERACEAE

Piriqueta caroliniana (Walt.) Urban – RU R, boundary trail; *9017*

TYPHACEAE

Typha domingensis Pers. – FP R; *9131*; new

ULMACEAE (excl. CELTIDACEAE)

Ulmus alata Michx. – CH F; *8496, 9414*
U. americana L. – CH F; SW I; *8376*
U. crassifolia Nutt. – CH F; *8484, 9413, 11132*

URTICACEAE

Boehmeria cylindrica (L.) Sw. – SW & FP R; *10937*
Urtica chamaedryoides Pursh – RU R; *9980*; new

VERBENACEAE (see also LAMIACEAE)

**Lantana camara* L. – RU R; *9079, 10164*
Lippia nodiflora (L.) Michx. – TM I; CH, SW, FL, FP & RU F; *8911* [= *Phyla nodiflora* (L.) Greene]
**Verbena brasiliensis* Vell. – RU R; *10201, 10552*; new
V. scabra Vahl – RU F; *9260, 9467, 10183, 10346*

VIOLACEAE

Viola affinis Le Conte – CH & SW O; *10022*
V. triloba Schwein. – CH & SW I; *9970*

VISCACEAE

Phoradendron leucarpum (Raf.) Reveal & M. C. Johnston – CH O; *9925*

VITACEAE

Ampelopsis arborea (L.) Koehne – CH & FL O; *10739*
Parthenocissus quinquefolia (L.) Planch. – CH & FL O; *10168*
Vitis aestivalis Michx. var. *aestivalis* – CH R; *10139*
V. cinerea (Engelm.) Engelm. ex Millardet var. *floridana* Munson – CH I; *9182, 9189*
V. rotundifolia Michx. var. *rotundifolia* – CH & FL R; *9183*
V. vulpina L. – CH R, forest gaps; *10135*; new

XYRIDACEAE

Xyris brevifolia Michx. – FL R; *9676*
X. caroliniana Walt. – FL R; *11000*

APPENDIX 2

LIST OF CHAROPHYTES, LIVERWORTS, MOSSES, AND MACROLICHENS OF WACASASSA BAY STATE PRESERVE

Each name is followed by a brief comment on habitat or substrate, an abundance value abbreviation, and collection number(s) of J. R. Abbott. Voucher specimens are housed in FLAS. Abundance categories are: Rare (R), Infrequent (I), Occasional (O), Frequent (F), and Abundant (A). See text for detailed information on these collections.

CHAROPHYTES

CHARACEAE

Chara zeylanica Kl. ex Willd. – two freshwater pools, R; *9443, 9792*
Nitella capillata A. Br. – one freshwater pool, attached to floating mats of *Bacopa monnieri,* R; *9999*

LIVERWORTS (HEPATICAE)

ADELANTHACEAE

Odontoschisma prostratum (Sw.) Trev. – cabbage palm trunks and wet soil in swamp, R; *B-559, B-584*

ANEURACEAE

Aneura pinguis (L.) Dum. – wet soil in swamp, R; *B-568a, B-582*
Riccardia latifrons Lindb. – wet fallen branches in swamp, R; *B-568*
R. multifida (L.) S. Gray – wet fallen branches in swamp, R; *B-530, B-566*

DILAENACEAE

Pallavicinia lyellii (Hook.) S. Gray – wet soil in swamp, R; *B-573*

FRULLANIACEAE

Frullania cobrensis Gott. ex Steph. – on *Taxodium* branchlets, R; *B-463*
F. eboracensis Lehm. – corticolous, R; *B-601*
F. kunzei (Lehm. & Lindb.) Lehm. & Lindb. – corticolous and on branches, A; *B-334, B-486*
F. obcordata (Lehm. & Lindb.) Lehm. & Lindb. – corticolous, I; *B-621*
F. squarrosa (Reinw., Blume & Nees) Nees – corticolous, I; *B-593*

LEJEUNEACEAE

Ceratolejeunea laetefusca (Aust.) Schust. – corticolous, R; *B-351*
Cheilolejeunea clausa (Nees & Mont.) Steph. – corticolous, F; *B-487*
C. rigidula (Nees & Mont.) Schust. – corticolous, A; *B-447, B-596*
Cololejeunea cardiocarpa (Mont.) Steph. – on corky *Liquidambar* saplings, R; *B-626*
Lejeunea cladogyna Evans – corticolous, I; *B-570*
L. flava (Sw.) Nees – corticolous and on logs, O; *B-436*
L. laetivirens Nees & Mont. – corticolous, O; *B-550, B-595*
Leucolejeunea unciloba (Lindenb.) Evans – corticolous, I; *B-620*
Mastigolejeunea auriculata (Wils. & Hook.) Schiffn. – corticolous, O; *B-433, B-440, B-591, B-615*
Microlejeunea ulicina (Tayl.) Evans ssp. *bullata* (Tayl.) Schust. – corticolous, on branches, and on logs, A; *B-607*

MARCHANTIACEAE

Marchantia domingensis Lehm. & Lindenb. – on moist limestone, R; *B-504, B-565*

PLAGIOCHILACEAE

Plagiochila dubia Lindenb. & Gott. – base of trees near water, O; *B-553, B-557, B-569*

RADULACEAE

Radula australis Aust. – corticolous, O; *B-432, B-480, B-556, B-590*

RICCIACEAE

Riccia fluitans L. – one freshwater pool, floating aquatic, R; *B-611*

MOSSES (MUSCI)

AMBLYSTEGIACEAE

Amblystegium varium (Hedw.) Lindb. – moist base of tree, R; *B-493a*

BRACHYTHECIACEAE

Homalotheciella subcapillata (Hedw.) Card. – corticolous, F; *B-460*
Rhynchostegium serrulatum (Hedw.) Jaeg. & Sauerb. – moist soil at base of tree, I; *B-491*

BRYACEAE

Bryum pseudocapillare Besch. – moist sandy soil, R; *B-461*

CALYMPERACEAE

Syrrhopodon incompletus Schwaegr. – primarily on cabbage palm trunks, A; *B-477, B-546, B-552*
S. texanus Sull. – on log near water, R; *B-572*

CRYPHAEACEAE

Cryphaea glomerata BSG. ex Sull – corticolous, O; *B-588, B-619*
Forsstroemia trichomitria (Hedw.) Lindb. – corticolous, O; *B-399*

DITRICHACEAE

Ditrichum pallidum (Hedw.) Hampe – sandy soil, R; *B-617*

ENTODONTACEAE

Entodon macropodus (Hedw.) C. M. – corticolous and on logs, I; *B-445*
E. seductrix (Hedw.) C. M. – corticolous and on logs, I; *B-349, B-427*

FABRONIACEAE

Schwetschkeopsis fabronia (Schwaegr.) Broth. – on logs, I; *B-560*

FISSIDENTACEAE

Fissidens cristatus Wils. ex Mitt. – moist base of trees and on logs near water, F; *B-435, B-478, B-575, B-579*
F. taxifolius Hedw. – moist log near water, R; *B-527*

HYPNACEAE

Isopterygium tenerum (Sw.) Mitt. – corticolous, on logs, and on moist soil, F; *B-350, B-414, B-549*

LESKEACEAE

Anomodon attenuatus (Hedw.) Hueb. – corticolous, I; *B-422, B-571*
A. rostratus (Hedw.) Schimp. – corticolous, R; *B-492*
Thelia hirtella (Hedw.) Sull. – corticolous, O; *B-400, B-489, B-567*

LEUCOBRYACEAE

Leucobryum albidum (Brid.) Lindb. – primarily near base of cabbage palm trunks, F; *B-434*
Octoblepharum albidum Hedw. – on cabbage palm trunks, R; *B-597, B-600*

LEUCODONTACEAE

Leucodon julaceus (Hedw.) Sull. – corticolous, O; *B-312, B-441*

METEORIACEAE

Papillaria nigrescens (Hedw.) Jaeg. & Sauerb. – corticolous, R; *B-624*

ORTHOTRICACEAE

Schlothemia rugifolia (Hook.) Schwaegr. – corticolous, R; *B-438*

POTTIACEAE

Barbula agraria Hedw. – moist limestone rocks, I; *B-622*
B. cancellata C. M. – moist sandy soil and limestone rocks, O; *B-420, B-574*

SEMATOPHYLLACEAE

Sematophyllum adnatum (Mx.) E. G. Britt. – corticolous, on logs, moist soil, and moist rocks, O; *B-598, B-606*

THUIDACEAE

Bryohaplocladium microphyllum (Hedw.) Wat. & Iwats. – moist soil, logs, and tree bases, I; *B-493* [= *Haplocladium microphyllum* (Hedw.) Broth.]
Cyrto-hypnum minutulum (Hedw.) Buck & Crum – moist soil, logs, and tree bases, I; *B-546* [= *Thuidium minutulum* (Hedw.) BSG.; Buck and Crum 1990]
Thuidium delicatulum (Hedw.) BSG. – moist soil, logs, and tree bases, I; *B-544, B-563*

MACROLICHENS

CLADONIACEAE

Cladina subtenuis (Abbayes) Hale & Culb. – on wooden bridge; *B-423*
Cladonia grayi G. Merr. ex Sandst. – on soil; *B-633*
C. leporina Fr. – on wooden bridge; *B-424*
C. peziziformis (With.) J. R. Laundon – on soil; *B-632*
C. ramulosa (With.) J. R. Laundon – on soil; *B-613*
C. ravenelii Tuck. – on soil and on bark; *B-422*

COLLEMATACEAE

Collema furfuraceum (Arnold) Du Rietz var. *luzone* (Rasanen) Degel.; *B-328a*
C. pulchellum Ach. var. *leucopeplum* (Tuck.) Degel.; *B-328*
Leptogium austroamericanum (Malme) C. W. Dodge; *B-329, B-456, B-562, B-578*
L. azureum (Sw.) Mont.; *B-583*
L. chloromelum (Sw. ex Ach.) Nyl.; *B-448, B-455*
L. cyanescens (Rabenh.) Koerber; *B-437*
L. marginellum (Sw.) Gray; *B-395*
L. phyllocarpum (Pers.) Mont.; *B-398*
L. stipitatum Vainio; *B-353*

PARMELIACEAE

Bulbothrix isidiza (Nyl.) Hale; *B-469*
Canoparmelia cryptochlorophaea (Hale) Elix & Hale; *B-466*
Parmotrema hypoleucinum (Steiner) Hale; *B-320*
P. perforatum (Jacq.) A. Massal.; *B-418*
P. rigidum (Lynge) Hale; *B-450*
P. tinctorum (Delise ex Nyl.) Hale; *B-327, B-415*
P. ultralucens (Krog) Hale; *B-325*
Pseudoparmelia sphaerospora (Nyl.) Hale; *B-326, B-333, B-457*
Punctelia rudecta (Ach.) Krog; *B-321*
Ramalina complanata (Sw.) Ach.; *B-585*
R. fastigiata (Pers.) Ach.; *B-331, B-335, B-338*
R. usnea (L.) R. Howe; *B-453*
R. willeyi R. Howe; *B-412, B-413, B-488*
Rimelia reticulata (Taylor) Hale & Fletcher; *B-462*
R. subisidiosa (Muell. Arg.) Hale & Fletcher; *B-464*
Usnea baileyi (Stirton) Zahlbr.; *B-339*
U. mutabilis Stirton; *B-602*
U. perplectata Mot.; *B-346*
U. rubicunda Stirton; *B-407*
U. strigosa (Ach.) Eaton; *B-482*
U. trichodea Ach.; *B-481*

PHYSCIACEAE

Dirinaria applanata (Fee) D. D. Awasthi; *B-470*
Heterodermia speciosa (Wulfen) Trevisan; *B-330*

Hyperphyscia syncolla (Tuck. ex Nyl.) Kalb; *B-324*
Physcia atrostriata Moberg; *B-323, B-401, B-612*
P. neogaea R. C. Harris; *B-630*
Pyxine caesiopruinosa (Tuck.) Imshaug; *B-543*

STICTACEAE

Lobaria ravenelii (Tuck.) Yoshim.; *B-525, B-592*

ADDENDUM A final site visit on February 13, 2000 yielded the following additions:

BRASSICACEAE

Rorippa teres (Michx.) Stucky – FP R; *13325*

RICCIACEAE

Ricciocarpus natans (L.) Corda – on exposed mud, R; *B–859*